

NASA

Energy  
A Continuing  
Bibliography  
with Indexes

NASA SP-7043(24)  
January 1980

National Aeronautics and  
Space Administration

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## ACCESSION NUMBER RANGES

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<i>IAA</i> (A-10000 Series)	A79-43833 – A79-54505
<i>STAR</i> (N-10000 Series)	N79-28118 – N79-34158

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# ENERGY

## A Continuing Bibliography

### With Indexes

### Issue 24

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from October 1 through December 31, 1979 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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# INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(24)) lists 1609 reports, journal articles, and other documents announced between October 1, 1979 and December 31, 1979 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

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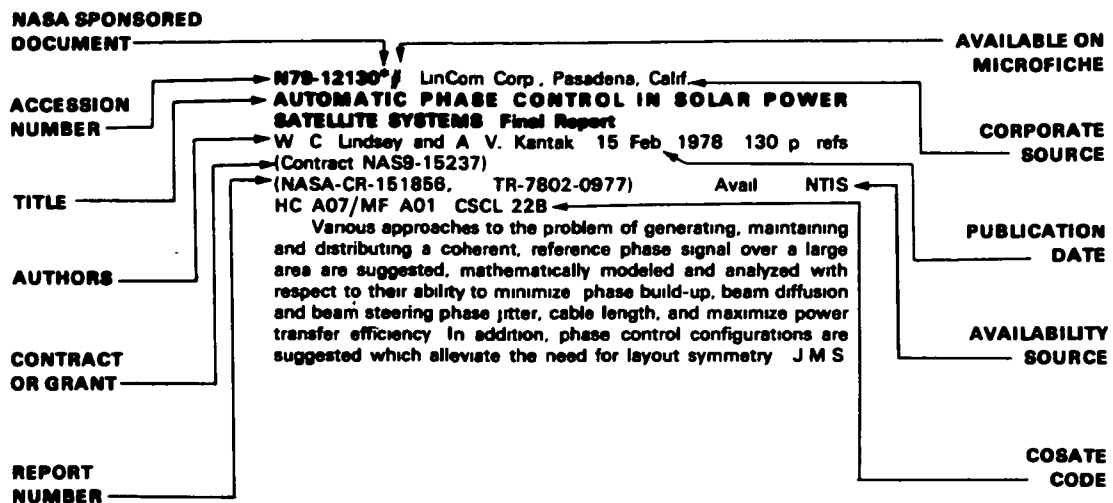


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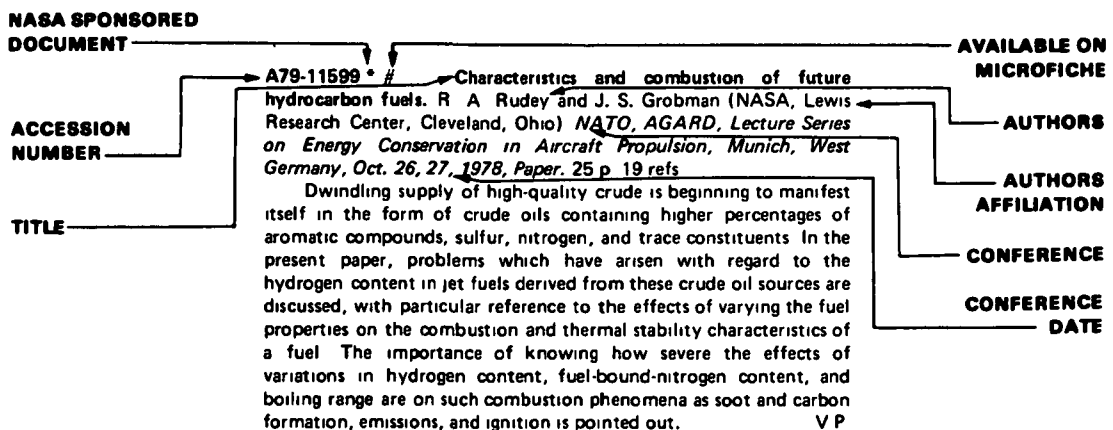
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4. Energy Research Information System, volume 3, no. 1 (Proj. nos. 00001081 through 00001224) --- bibliographies p0743 N79-29671
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### IAA ENTRIES

**A79-43848 #** Development of thermoelectricity studies in the USSR (Razvitiye issledovaniy po termoelektrichestvu v SSSR). A A Buriak Kiev, Izdatel'stvo Naukova Dumka, 1978 136 p 307 refs In Russian.

The historical background and current status of thermoelectric power generation in the USSR are reviewed. Consideration is given to the properties of the principal thermoelectric semiconductor materials as well as to methods for calculating the principal parameters of thermoelectric devices. The design and operation of specific types of thermoelectric generator systems, including solar thermoelectric generators, organic-fuel generators, and SNAP systems, are reviewed. B.J.

**A79-44160** Energy analysis of the Solar Power Satellite. R A Herendeen, T Kary, and J Rebitzer (Illinois, University, Urbana, Ill.) *Science*, vol 205, Aug 3, 1979, p 451-454 25 refs

The energy requirements to build and operate the proposed Solar Power Satellite are evaluated and compared with the energy it produces. Because the technology is so speculative, uncertainty is explicitly accounted for. For a proposed 10-gigawatt satellite system, the energy ratio, defined as the electrical energy produced divided by the primary nonrenewable energy required over the lifetime of the system, is of order 2, where a ratio of 1 indicates the energy breakeven point. This is significantly below the energy ratio of today's electricity technologies such as light-water nuclear or coal-fired electric plants. (Author)

**A79-44225 \* #** Energy and cost savings results for advanced technology systems from the Cogeneration Technology Alternatives Study (CTAS). G. D Sagerman, G J. Barna, and R K Burns (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, Orlando, Fla, June 4-6, 1979, Paper 79-1000* 20 p Contract No EC-77-A-31-1062

The Cogeneration Technology Alternatives Study (CTAS), a program undertaken to identify the most attractive advanced energy conversion systems for industrial cogeneration applications in the 1985-2000 time period, is described, and preliminary results are presented. Two cogeneration options are included in the analysis: a topping application, in which fuel is input to the energy conversion system which generates electricity and waste heat from the conversion system is used to provide heat to the process, and a bottoming application, in which fuel is burned to provide high temperature process heat and waste heat from the process is used as thermal input to the energy conversion system which generates energy. Steam turbines, open and closed cycle gas turbines, combined cycles, diesel engines, Stirling engines, phosphoric acid and molten carbonate fuel cells and thermionics are examined. Expected plant level energy savings, annual energy cost savings, and other results of the economic analysis are given, and the sensitivity of these results to the assumptions concerning fuel prices, price of purchased electricity and the potential effects of regional energy use characteristics is discussed. C K.D.

**A79-44239** Turning to the sun for power. J Hopkinson *EPRI Journal* vol 4, June 1979, p 18-21

Problems of supply and collection in solar-thermal conversion are discussed. A solar thermal power plant concept is described which incorporates a closed Brayton-cycle (gas turbine) system. Advantages of the Brayton cycle are its reduced need for cooling water and higher efficiency due to recycling or not exhaust air back to the receiver. These factors increase siting flexibility and reduce land requirements, respectively. A 1-MW (th) solar receiver is described which uses air, heated from 1000 F to 1500 F, as the working fluid. Also studied is an open Brayton cycle central receiver concept which heats air to 2000 F to achieve higher thermal efficiency. Finally, a solar-fossil hybrid turbine is described, as a means of back-up generation to ensure a constant power supply. M.E.P.

**A79-44241 #** Fusion - Its status and outlook. W B. Briggs (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In *Energy: A close look at the energy business, Proceedings of the Second International Conference, Washington, D.C., November 30, December 1, 1978* Stamford, Conn., Business Communications Co., Inc., 1979, p 133-155

The potential of fusion is examined and realistic dates for its utilization are projected. Fusion fundamentals are discussed, noting that in fusion there are no noxious effluents and no fuel cycle that requires expensive control. Governmental and commercial fusion R&D are surveyed and attention is given to the major obstacles. (1) institutional - fusion central power plants must be compatible with the distribution system and economically attractive to displace known entities such as fossil fuel or nuclear fission plants, (2) financial - research money must come from national governments, and (3) technical, i.e., multidiscipline engineering must be applied to make an efficient subsystem and engineering at the limit of theoretical knowledge. Finally, world wide research project developments are surveyed and some aspects of fusion economics studied. M.E.P.

**A79-44242 #** The future of methane supply. C G Matthews (Brooklyn Union Gas, Brooklyn, N.Y.). In *Energy: A close look at the energy business, Proceedings of the Second International Conference, Washington, D.C., November 30, December 1, 1978* Stamford, Conn., Business Communications Co., Inc., 1979, p 170-176

Recent developments in the natural gas industry are surveyed. Advantages of methane are stressed, and include its ability to be utilized in many energy applications with minimal environmental impact, and that an effective distribution network already exists. Sources discussed include geopressure zones, tight formations, and biomass. A study is cited, which concludes that for its existing systems, coal-based gas would provide a cheaper and more efficient energy form than coal-based electricity while another study found that coal gasification would be up to 50% more efficient than coal electrification and result in lower air pollution, lower solid waste generation, and lower water requirements. M.E.P.

**A79-44255** Study of photovoltaic characteristics dependence on solar ray incidence angle and intensity. M M Koltun, I. V. Karpenko, V. P. Matveev, Iu N Ksendzatskaia, I. S Orshanski, T.

A. Kozyreva, and G. D. Naumova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). (*Geliotekhnika*, no. 5, 1978, p. 3-6.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 1-3. Translation.

The characteristics of silicon and thin-film Cu<sub>2</sub>S-CdS photocells are studied for various solar radiation incidence angles. It is found that for the silicon solar batteries with variable sunlight incidence angles creation of microrelief on the outer surface of the protective glasses by pregrinding of these surfaces is most effective. For the thin-film Cu<sub>2</sub>S-CdS heterosystem solar batteries of improved angular characteristics are obtained when using polycrystalline films with micrograin dimensions from 0.5 to 1.5 microns. The results obtained show that under low illumination and variable solar ray incidence angle conditions thin-film photocells may be more effective than silicon photocells. (Author)

**A79-44259** Calculating the radiant field of concentrators with artificial sources. S. A. Azimov, G. T. Adylov, Kh. M. Mallayeva, I. I. Pirmatov, and T. T. Riskiev (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). (*Geliotekhnika*, no. 5, 1978, p. 27-31.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 19-22. 6 refs. Translation.

A general scheme for the analysis of concentrators with arbitrary radiation sources is proposed. The analysis takes into account reflector inaccuracies which are significant when the source angular dimensions are comparable with the mean-square deviations of the reflector surface normal from the ideal direction. As an example, consideration is given to the radiation field of the 'Uran' radiative heating unit. B.J.

**A79-44260** Solar radiation concentrator for uniform irradiation of flat energy receivers and converters. D. I. Teplakov and R. R. Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 5, 1978, p. 32-40.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 23-29. 9 refs. Translation.

**A79-44261** Accuracy and energy characteristics of paraboloidal heliostat system. R. A. Zakhidov and A. A. Vainer (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priboroostroeniya, Uzbek SSR). (*Geliotekhnika*, no. 5, 1978, p. 41-44.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 30-32. Translation.

A general theory developed by Zakhidov et al. (1977) for multimirror concentrating systems is used to analyze a paraboloidal heliostat system. Consideration is given to both aperture/dimensional design and accuracy/energy design. B.J.

**A79-44262** Composite paraboloidal radiant energy concentrators. L. Ia. Paderin (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 5, 1978, p. 45-51.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 33-37. Translation.

Calculations are presented for an axisymmetric paraboloidal composite mirror-type concentrators exposed to solar flux parallel to the concentrator axis. The concentrators are sets of conical or spherical rings of equal width which intersect at their initial and final sections the generating surfaces. It is shown that the solar flux concentration efficiency of conical-ring paraboloids is low, while that of spherical-ring paraboloids is high. B.J.

**A79-44263** Optimization model of a system consisting of solar water heater plus accumulator plus user with variable heat carrier flowrate. V. B. Kozlov and Iu. B. Rudiaik (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 5, 1978, p. 52-57.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 38-42. Translation.

**A79-44264** Experimental study of mass exchange in glazed solar solution regenerator. A. Kakabaev, O. Klyuchayeva, A.

Khandurdyev, and O. Tuiliev (Akademiya Nauk Turkmeniskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). (*Geliotekhnika*, no. 5, 1978, p. 58-61.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 43-45. Translation.

Some experimental results on heat transfer for a laboratory model of a solar regenerator are discussed. Mass transfer from the aqueous lithium chloride solution flowing over the regenerator surface to the air flowing through the slot formed by the glass and regenerator surface is studied as a function of surface heating intensity, regenerator inclination to the horizon, and degree of flooding of the surface by the solution. Empirical relations for determining the mass transfer coefficient are derived. B.J.

**A79-44265** Thermodynamic analysis of water thermolysis in a solar furnace to obtain hydrogen. Sh. D. Shakhbazov and P. F. Rzaev (Akademiya Nauk Azerbaidzhaniskoi SSR, Sektor Radiatsionnykh Issledovaniy, Azerbaidzhan SSR). (*Geliotekhnika*, no. 5, 1978, p. 72-74.) *Applied Solar Energy*, vol. 14, no. 5, 1978, p. 54-56. Translation.

**A79-44273** # Ocean thermal energy for the 80's. G. L. Dugger (Johns Hopkins University, Baltimore, Md.). *AIAA Student Journal*, vol. 17, Summer 1979, p. 14-19. 13 refs.

The use of sea water as a means of producing energy, through a process of open-cycle or closed-cycle Ocean Thermal Energy Conversion (OTEC), is presented. The possibility of producing energy-intensive products, such as ammonia, liquid hydrogen or aluminum on plantships cruising the high seas seeking the highest change in temperature at all times was examined and it was determined that the costs for such plants in the Atlantic Ocean (several hundred miles east of Brazil) would range between \$800 and \$1,000 per kWh or 14-17 mills per kWh onboard electrical costs. A proposal to construct an ammonia producing plant in the South Atlantic, capable of providing up to 40 MW for Puerto Rico's power consumption during the next decade, is studied. Due to the expected rise in U.S. ammonia use in fertilization and chemical manufacture, OTEC plant sizes of 200-400 MWe are projected, emphasizing the need to modify existing shipyards and raise the necessary capital investment costs of \$200-\$600 million. C.F.W.

**A79-44275** # A realistic alternative for practical fusion power. R. W. Bussard. *AIAA Student Journal*, vol. 17, Summer 1979, p. 24-26. 48.

An alternative approach to practical fusion power that is less expensive and more solidly based on known technology and physics is presented. The RIGGATRON 'throwaway' tokamak is similar to all other tokamaks except that it is designed to operate at magnetic fields sufficiently high to allow attainment of fusion ignition directly by plasma ohmic heating alone, without exceeding the limits of plasma current and density for stable confinement. The small size of the RIGGATRON, ten times smaller than mainline tokamaks, results in a more than 1000-fold reduction in unit costs, leads to low-cost R&D and allows operation in a 'throwaway' or disposable/recyclable mode. It is also found that the lifetime cost of RIGGATRONs are between \$1 and \$3 million per kWh hr of net power delivered to user loads. C.F.W.

**A79-44278** # Future energy alternatives. J. Grey (Long Island University, Brookville, American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). *AIAA Student Journal*, vol. 17, Summer 1979, p. 28-31.

Future energy sources such as photovoltaic arrays, solar thermal electric systems, biomass energy, gasohol, wind energy, water power and geothermal energy are discussed. It is noted that the energy problems do not lie in federal R&D, but in the implementation of nationwide and worldwide systems and it is suggested that massive implementation of building and appliance efficiency standards, industrial and commercial cogeneration of electrical power and heat, and capital-intensive options such as district heating via power plant waste, be developed to reduce our expanding energy requirements. C.F.W.

**A79-44277 #** The solar power satellite concept. P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *AIAA Student Journal*, vol 17, Summer 1979, p 32-41. 25 refs

A method to utilize solar energy through solar power satellites (SPS) is presented. The electricity produced by solar energy conversion will be fed to microwave generators forming part of a planar, phased-array transmitting antenna, which in turn is designed to direct a microwave beam to one or more receiving antennas. Variations in solar power output due to eclipses, equinox periods and other predictable interruptions, are expected to range from 1.309 kW/sq m to 1.399 kW/sq m. Technological options for solar energy conversion, including photovoltaic and thermal-electric processes are described. Attention is also given to the assembly and maintenance of SPS, economic and environmental implications, as well as microwave biological effects and other impacts, which include thermal pollution, land despoilment and resource consumption.

C.F.W.

**A79-44294** Transient plate temperature in flat plate solar collectors. J K Nayak, I C Goyal, S C Kaushik (Indian Institute of Technology, New Delhi, India), and M. A. S. Malik (Kuwait Institute of Scientific Research, Kuwait). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1979, p 8-10.

An analysis of the rise in temperature of plate and insulation in a flat plate solar collector when the flow of fluid in the collector stops (which could happen accidentally) is presented. The equation of heat conduction in the insulation is solved, in accordance with the energy-balance conditions, to obtain a temperature distribution in insulation. As a special case this leads to the variation of the temperature of the top layer of the insulation (i.e., that of the plate). The results are shown to be in good agreement with those of a simulated experiment.

(Author)

**A79-44295** How a wall uses solar energy (Comment un mur utilise-t-il l'énergie solaire). F.-M. Camia (Ecole d'Architecture de Luminy, Marseille, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1979, p 11-17. 7 refs. In French

The captation of solar energy by opaque walls is analyzed. A simple formulation of the transfer function for a wall is obtained on the basis of the assumption that the latter can be represented as the sum of a constant mean energy and a sinusoidal variation. These expressions are used to evaluate the coupled effects of conduction and convection. The elements of the intrinsic reaction of the wall are calculated and directly applied to time tables of the energy received. The analysis indicates that the energy transfer regime is strongly influenced by the value of the coefficient of external exchange. It also shows that convection is a serious obstacle to captation of solar energy by walls.

C K D.

**A79-44296** Regulation of the water steam cycle in a solar receiver. G. Francia (CNR, Rome, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1979, p 18-26

On the basis of heat and energy distribution calculations, a regulation system for the water-steam cycle of a solar boiler has been designed. The system is intended to maintain steam exiting from the boiler at a constant temperature and relatively constant volume. Water temperature is regulated at a given point during the preheating stage by comparing the temperature measured by a sensor with the theoretical value and making appropriate adjustments in the main flow rate. The steam titer in the evaporation zone is controlled by a second regulator on the basis of measurements transmitted from temperature and pressure sensors located in the superheater. A final stage of regulation is accomplished by an attenuator located in the end section of the superheater. The operation of the system when the energy input drops to zero is examined, together with the case in which energy input is abruptly resumed after several hours of interruption.

C K D

**A79-44298** The use of solar energy to provide heat and hot water for the students' residence of the Ecole des Mines in Alès, France (Chauffage et production d'eau chaude par l'énergie solaire a la maison des Elèves de l'Ecole des Mines d'Alès). J.-C. Vezilier. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1979, p 33-38. In French

**A79-44365** Solar concentrator flux distributions using backward ray tracing. J C Daly (Rhode Island, University, Kingston, R.I.). *Applied Optics*, vol 18, Aug 1, 1979, p 2696-2699. 7 refs

Flux distributions produced by parabolic and circular cylinder solar concentrators subject to surface slope errors and defocusing are determined. The technique developed traces a set of rays from a point on the absorber back through the concentrator optics to the sun. The solar flux at the absorber point is the sum of the flux associated with each ray. Various models of the solar disk are introduced by weighting the flux associated with each ray as a function of where it strikes the solar disk.

(Author)

**A79-44504** Passive solar heating for buildings. J D Balcomb (California, University, Los Alamos, N Mex). In The passive collection of solar energy in buildings, Proceedings of the Conference, Royal Institution of Great Britain, London, England, April 24, 1979. Conference sponsored by the International Solar Energy Society, London, International Solar Energy Society, 1979, p. 75-85. 11 refs. Research sponsored by the U.S. Department of Energy and Office of the Assistant Secretary for Conservation and Solar Applications.

A survey of passive solar heating experience is presented. Design approaches reviewed include (1) direct gain, (2) thermal storage wall, (3) attached sun space, (4) thermal storage loops, and (5) convective loop. Consideration is also given to generic categories (a) direct, (b) indirect, and (c) isolated. Data is given showing that passive heating can be successful in regions such as Boston, Mass. and Seattle, Wash. Advantages cited include low cost, ease of natural operation, thermal comfort, few needs for certification, and esthetic appeal. The Los Alamos program of performance simulation and evaluation is described and a simplified method of performance estimation is outlined.

M E P

**A79-44525** Electrostatic separation of coal macerals. J M Anderson (Joy Manufacturing Co., Kitchener, Ontario, Canada), L. Parobek (Hi-Rel Laboratories, Monrovia, Calif.), M A Bergougnou, and I. I. Inculat (Western Ontario, University, London, Canada). *IEEE Transactions on Industry Applications*, vol 1A-15, May-June 1979, p. 291-293. 6 refs. Research supported by the Department of Energy, Mines, and Resources of Canada.

Present threats of energy shortages have placed an increasing importance on coal as a fossil fuel. Government restrictions on the maximum permissible SO<sub>2</sub> content in coal burning plant effluents have necessitated sulphur reduction processes. By using an apparatus developed by the researchers at the University of Western Ontario, it has been demonstrated that constituent macerals of the coal may be successfully triboelectrified and then separated in electrostatic fields. The electrification and separation of the pyrite maceral from coal by means of dilute phase fluidization and electric fields is discussed. Some results are also presented on the separation of the vitrinite, fusinite, exinite, and micrinite macerals as well as of coal fractions with high ash content. The results show the effectiveness of the triboelectrification of the macerals in contact with one another and with the material used in the construction of the separator.

(Author)

**A79-44526** Advances in cryogenic engineering. Volume 24. Proceedings of the Second International Cryogenic Materials Conference, University of Colorado, Boulder, Colo., August 2-5, 1977. Conference sponsored by the U.S. Navy. Edited by K D Timmerhaus (Colorado, University, Boulder, Colo.), R P Reed, and A F Clark (National Bureau of Standards, Institute for Basic

Standards, Boulder, Colo.) New York, Plenum Press, 1978 597 p \$49 50

Volume 24 of *Advances in Cryogenic Engineering* reflects the growing awareness that many materials have great potential for various low-temperature applications. The papers explore basic information on the behavior of low-temperature materials which is essential to all aspects of cryogenic research. Problem areas of interest include ferrous alloys, nonferrous alloys, physical properties of structural alloys, composites, stress effects of superconductors, pinning in superconductors, multifilamentary superconductors, film- and tape-type superconductors, special electrical materials, and U S /USSR exchange program on LNG materials research S D

**A79-44527** Large superconducting magnets for new energy technologies. M N Wilson (MIT, Cambridge, Mass.) In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 1-16 35 refs ERDA-supported research

The paper describes three energy conversion technologies which demand the use of superconducting magnets on a scale that is extremely large compared to anything attempted so far. They are MHD power generation, controlled thermonuclear fusion, and magnetic energy storage. Some general magnet design problems are discussed and their implications for each system considered. The problems selected are stability, stress, and safety. These are surely not the only problems involved, but they probably bear more strongly on the design of these magnets than any other S D

**A79-44537** Fracture strength of thick 5083-O aluminum alloy for LNG storage tanks. K. Ikeda, Y. Miyagi, M. Aoki, and T. Shirakura (Kobe Steel, Ltd., Amagasaki, Japan). In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 166-174. 6 refs

**A79-44545** Resistance to strain degradation in preliminary UWMAK TF coil conductors for fusion reactors. S O. Hong, P F. Michaelson, I N. Sviatoslavsky, and W C Young (Wisconsin, University, Madison, Wis.). In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 341-349 5 refs ERDA-supported research

An embedded conductor design concept for the UWMAK toroidal field magnets was developed and tested with results of fatigue tests performed on a prototype model reported, including epoxy-bond integrity, high voltage breakdown characteristics, and the change in the resistance of a copper stabilizer due to cyclic loading of the model at cryogenic temperatures. The three major advantages are outlined: (1) efficient utilization of structural material for both radial and lateral loads, (2) reduction of friction-generated heat by minimizing conductor movement, and (3) capability of testing each disk of a cryostat under simulated operating conditions prior to assembling it into a completed magnet V T

**A79-44546** High-current Al-TiNb composite conductor for large energy storage magnets. S G. Ladkany (Wisconsin, University, Madison, Wis.). In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 374-382 20 refs. Research supported by the Wisconsin Electric Utilities Research Foundation, Wisconsin Alumni Research Foundation, ERDA, and NSF

The design of a circular cryogenically stable high-current Al-TiNb composite conductor is presented, such that the extremely soft but highly desirable high-purity aluminum is tightly and

completely confined inside thin shells of high-strength aluminum. The conductor is also reinforced with high-strength webs, which provide axial, circumferential, and flexural strength. The conductor is torsionally stiff and structurally self-supporting, it accommodates discrete, instead of continuous, supports, allowing for cooling along its entire length. Such open surface cooling provides for high current density in the aluminum stabilizer. Criteria are given for the separation between adjacent windings in a magnet which would allow for adequate cooling. One 45-kA conductor model has been constructed, and its use for large energy storage magnets and poloidal field coils in fusion reactors is under investigation (Author)

**A79-44549** Low-temperature, fracture properties of a USSR aluminum-6% magnesium alloy. H I. McHenry, S E. Naranjo, D T. Read, and R P. Reed (National Bureau of Standards, Boulder, Colo.) In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 519-528 10 refs

**A79-44550** Fracture toughness of cryogenic alloys. A W. Pense, R D. Stout, and B R. Somers (Lehigh University, Bethlehem, Pa.) In *Advances in cryogenic engineering. Volume 24 - Proceedings of the Second International Cryogenic Materials Conference, Boulder, Colo., August 2-5, 1977* New York, Plenum Press, 1978, p 548-559. 7 refs. Research sponsored by the Welding Research Council, Nippon Steel Corp., and NSF

The paper explores the use of the newer cryogenic materials in the light of recent developments to ensure the strength and toughness appropriate for liquid natural gas (LNG) service. Included are data obtained from fracture tests on an austenitic manganese steel weldment and a special aluminum alloy. The materials studied are ASTM A553 Type I, ASTM A645, N-TUF CR-196, OX13AG19, AMg6, and 5083-O (4 4%-Mg Al alloy, ASTM B209). The fracture toughness specimens employed are compact tension and bend specimens, which are limited in thickness by the available plate. These plate thicknesses are near the maximum used or contemplated for use in LNG service. Summary tables are presented relative to chemical compositions of the materials, tensile and fracture toughness test results, and critical through-flaw stress in a 25-mm plate and critical through-flaw size at half yield stress. Several pertinent graphs are also included S D

**A79-44551** Meteorology for solar energy applications, *Proceedings of the Conference, Royal Institution of Great Britain, London, England, January 24, 1979*. London, International Solar Energy Society, 1979 129 p \$13 60

A series of articles on meteorological studies and modeling techniques which are applicable to the design or operation of solar energy systems is presented. Topics include the radiance distribution of clear and overcast skies; measurements of inclined surface irradiance, studies of the spectral irradiance of direct radiation and global radiation in the UK, the effect of environmental parameters of the performance of flat plate solar collectors, a solar radiation data acquisition program, solar radiation measurements at the UK Meteorological Office, values of the turbidity coefficient for different classes of radiation day, and mathematical models for estimating the irradiance at an inclined surface under different conditions and predicting hourly temperature, wind speed and long wave radiation variations C K D.

**A79-44557** The influence of environmental parameters on flat plate solar collector performance. A A. Green (University College, Cardiff, Wales). In *Meteorology for solar energy applications, Proceedings of the Conference, London, England, January 24, 1979* London, International Solar Energy Society, 1979, p 95-107 8 refs

Results of computer modeling of single- and double-glazed flat plate solar collectors are presented, in the form of conventional collector performance characteristics, indicating the influence of wind speed, ambient air temperature and effective sky temperature on collector steady-state efficiency, for moderate values of other parameters. Variations in air temperature, and in wind speed for low wind speeds (less than 6 m/sec) are shown to have more significant effects than probable variations in effective sky temperature. The simplified computer models used in the investigation are described in an appendix. They are based on one-dimensional, steady-state heat transfer analyses of single- and double-glazed collectors and utilize recently published empirical results of convective heat transfer studies. The models take into account absorption of solar radiation by the transparent cover(s) and multiple reflection of solar radiation between the absorber plate and transparent cover(s) in a collector.

(Author)

**A79-44580**      **Photosynthetic pathway and biomass energy production** D. L. Marzola and D. P. Bartholomew (Hawaii, University, Honolulu, Hawaii) *Science*, vol 205, Aug 10, 1979, p 555-559 61 refs

Three plant species are compared in their photosynthetic abilities to provide useful energy in the form of alcohol when grown in a tropical environment. An evaluation of growing requirements, photosynthetic productivity, water use efficiency, energy requirements for production and yields of fermentable substrates is presented for cassava, sugar cane and pineapple. Production records for sugar cane and pineapple grown under a high level of management in Hawaii and cassava grown experimentally in Costa Rica and Jamaica reveal that carbohydrate production per hectare per month decreases from pineapple to sugar cane to cassava. It is pointed out that pineapple is well adapted to the subhumid or semiarid tropics and thus the growing of pineapple for energy conversion is particularly well suited to the exploitation of large areas not currently under cultivation.

A. L. W.

**A79-44715**      **Proton radiation effects on Cr-MIS single-crystal Si solar cells.** R. Ferraglio (Rutgers University, Piscataway, U.S. Navy, Naval Air Engineering Center, Lakehurst, N.J.) and W. A. Anderson (Rutgers University, Piscataway, N.J.) *Applied Physics Letters*, vol 35, July 1, 1979, p 18-20 8 refs

Cr-MIS solar cells on single-crystal Si, with a 2-sq-cm area and approximately 10% efficiency, have been subjected to 1.0- and 1.6-MeV proton radiation at total dosages of up to 3.3 times 10 to the 13th/sq cm. Photovoltaic studies reveal characteristic short-circuit current and open-circuit voltage degradation similar to proton-irradiated junction-type solar cells. Spectral response measurements reveal output decay primarily due to minority-carrier diffusion-length decreases of up to 96%.

(Author)

**A79-44721**      **Photovoltaic effect in Cu/CuGaSe<sub>2</sub> Schottky barriers** J. Stankiewicz and W. Giriat (Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela) *Applied Physics Letters*, vol 35, July 1, 1979, p 70, 71. Research supported by the Consejo Nacional de Investigaciones Científicas y Tecnológicas.

Cu/CuGaSe<sub>2</sub> Schottky barriers have been prepared by vacuum deposition of copper on p-type CuGaSe<sub>2</sub> single crystals with a resistivity of 0.01 ohm-cm. The photovoltaic properties of such cells have been investigated. Under the AM1 condition these cells exhibit a solar-energy conversion efficiency of 3.5 percent.

(Author)

**A79-44790 #**      **Annular diffuser performance for an automotive gas turbine.** D. Japikse (Creare, Inc., Hanover, N.H.) and R. Pampreen (Chrysler Corp., Gas Turbine Engineering and Research Office, Detroit, Mich.) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-147*) *ASME, Transactions, Journal of Engineering for Power*, vol 101, July 1979, p 358-372 17 refs.

A series of experimental tests and computational analyses are reported for two automotive gas turbine diffusers. The diffusers

include an interstage and an exhaust diffuser plus collector. The diffuser models were tested at Reynolds numbers and inlet blockage levels characteristic of the engine operating conditions. A rig test of the interstage diffuser is also reported. Inlet swirl and Mach number were systematically varied in the model tests. Good recovery was found for each diffuser at zero swirl. Recovery degraded at high swirl for the interstage diffuser. The exhaust diffuser with a double discharge collector showed little sensitivity to inlet swirl. Flow visualization indicates that the interstage diffuser was separated at modest swirl levels, at least in the model test. Pressure recovery in the rig (with upstream rotor and downstream stator) was found to be greater than in the model test (using 'clean' inlet conditions). Comparisons between measured wall pressures and calculations provide further basic insights.

(Author)

**A79-44793 #**      **Design and development of a low emission combustor for a car gas turbine.** I. Holzapfel and F. J. Meyer (Daimler-Benz AG, Stuttgart, West Germany) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-155*) *ASME, Transactions, Journal of Engineering for Power*, vol 101, July 1979, p 422-430 11 refs.

**A79-44796 \***      **The engineering analysis of solar radiation.** M. S. Reid, C. L. Hamilton, and O. V. Hester (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *International Journal of Policy Analysis and Information Systems*, vol 2, July 1978, p 187-217 12 refs. Contract No. NAST-100.

A necessary precursor to construction of well-designed, efficient, and economically viable solar energy systems is the engineering analysis not only of the systems themselves but also of the solar radiation that will drive them. This paper presents the first steps in such an analysis to support the design of solar thermal power systems. A rationale for development of an integrated approach to this analysis is outlined, and elements of the approach are described. A dynamic computer simulation of a conceptual system was employed in an initial sensitivity analysis to explore how performance estimates might be affected by the precision and amount of detail in solar radiation data used as model input. A measurement program, including instrumentation, used to characterize precisely and in detail the solar resource at one location is described as is a probabilistic model derived from it, for predicting insolation as a function of time.

(Author)

**A79-44873**      **Gas concentration cells for the conversion of ocean wave energy.** R. E. Salomon and S. M. Harding (Temple University, Philadelphia, Pa.) *Ocean Engineering*, vol 6, no 3, 1979, p 317-327 6 refs. Contract No. ET-78-S-05-5669.

The concept of using electrochemical gas concentration cells to convert the mechanical potential energy of ocean waves to electricity using a taut-moored buoy is analyzed. Several idealized embodiments are discussed and one of these is shown to have particular merit. Some results obtained in an experimental program aimed at developing such a system are described. In particular, an electrochemical cell employing the protonically conducting synthetic polymer Nafion, bounded by platinum electrodes, has been studied in a manner which simulates the operation of such a device within a taut-moored buoy subject to ocean waves. It is shown that with some modest engineering advances, this system is indeed capable of converting a significant fraction of ocean wave energy into electricity.

(Author)

**A79-44914 #**      **A new three-dimensional equivalent circuit of diagonal type MHD generator.** M. Yoshida, K. Komaya, and J. Umoto (Kyoto University, Kyoto, Japan) *Kyoto University, Faculty of Engineering, Memoirs*, vol 41, Apr 1979, p 96-108 8 refs.

For a large scale diagonal type generator with oil combustion gas plasma, a new three-dimensional equivalent circuit is proposed, in which are considered the leakage resistance of the duct insulator



surface, the boundary layer, the ion slip, the effect of the finite electrode segmentation, etc. Next, through the relation between the Hall voltage per one electrode pitch region and the load current obtained by use of the equivalent circuit, a suitable size and number of the space elements per region are determined. Further, by comparing in detail the electrical performances of two types of the diagonal generators with diagonal conducting and insulating sidewalls, three-dimensional effects of the sidewalls are discussed.

(Author)

**A79-44915 #** A theoretical analysis of neutral beam probe for measuring ion temperature of a plasma. H-T Yip, H Nishihara (Kyoto University, Kyoto, Japan), and S Yano (Kobe University of Mercantile Marine, Kobe, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol 41, Apr 1979, p 159-167 5 refs

A theoretical basis of the neutral beam probe for measuring the local ion temperature of a plasma is given. The results of numerical calculations for some typical plasmas show that it is desirable to choose the beam energy in the region of 10 keV to 30 keV for plasmas of current and of next generation tokamaks. It is pointed out that the method of least squares can be applied to determine the local ion temperature from the measured data.

(Author)

**A79-44916 #** Construction of Lur'e type Lyapunov function with effect of magnetic flux decay. N Kakimoto, Y Ohsawa, and M Hayashi (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol. 41, Apr 1979, p. 168-186 11 refs

In this paper a generalized stability criterion for a system with multi-argument nonlinearities is derived. The new criterion is based on Pao's work, and is proved along with Anderson's criterion. The new criterion makes it possible to construct a Lur'e type Lyapunov function in a systematic way. The new criterion is applied to a multi-machine power system with magnetic flux decays of generators. A new Lyapunov function is constructed in a well known manner established by Willems and other researchers. The new Lyapunov function is similar to the one which has already been obtained for a system without the magnetic flux decays, except for a few points which will affect the transient stability of the system.

(Author)

**A79-44919** Open-circuit to short-circuit switching - Method for lifetime measurement in solar cells. S R Dhariwal, N Basu, and R Gadre (Government College, Ajmer, India). *Electronics Letters*, vol 15, July 19, 1979, p 456-458 5 refs. Research supported by the University Grants Commission of India.

A new method is suggested for measurement of lifetime of photoinjected carriers in the base layer of a p-n junction solar cell. The cell is switched from the open-circuit to the short-circuit mode of operation by using a negative voltage pulse. C.R.O. trace of the output voltage pulse provides a direct means for lifetime measurement.

(Author)

**A79-44957** Coal usage (Kohlenverwendung). H-D Schilling (Bergbau-Forschung GmbH, Essen, West Germany). *Brennstoff-Warme-Kraft*, vol 31, Apr 1979, p 125-130 144 refs. In German.

Different methods for processing coal with regard to efficiency and reduced pollution, are surveyed. Among these are new technologies for the production of coke. Attention is given to electricity and heat generation, noting that this represents two thirds of the primary energy usage. Fluidized bed reactors, with some seeing applications in the near future, are covered. The use of nuclear heat in the process of gasification is mentioned. Other topics discussed include coal liquefaction and new procedures on the basis of active charcoal from stone coal.

M E P

**A79-44958** Renewable energy sources (Regenerative Energiequellen). M Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Warme-Kraft*, vol 31, Apr 1979, p 147-154 73 refs. In German.

A survey of renewable energy sources is presented with consideration given to the significance of such sources for West Germany. Discussion includes the use of low temperature collectors and heat pumps for household use, since over 80% of the energy used in this area is for heating and hot water production. Heat pumps powered by Volkswagen engines are also covered with data presented showing the number of such units in use and operating costs. Further attention is given to high temperature collectors and solar cells for general power supply, with solar farms and solar towers mentioned in particular. Other topics discussed include wind power and geothermal energy. Finally, research in other nations is examined, noting that the emphasis is also on solar energy.

M E P

**A79-44959** Energy storage (Energiespeicherung). U Kaier (Kraftanlagen AG, Heidelberg, West Germany). *Brennstoff-Warme-Kraft*, vol 31, Apr 1979, p 156-158 53 refs. In German.

Various methods of energy storage are surveyed. Systems are described according to type of application and working medium. Attention is given to the three areas in which R&D is being undertaken: (1) energy storage in systems for electricity and power generation, (2) central heat storage for heating from remote sources, (3) decentralized small heat reservoirs in the household area. In addition, the operating economy of several systems of energy storage such as thermal oil, steam, hydrogen, and flywheel, are detailed.

M E P

**A79-44979 #** Fokker-Planck/transport analyses of fusion plasmas in contemporary beam-driven tokamaks. A A Mirin, M G McCoy, J Killeen, M E Rensink, D E Shumaker (California, University, Livermore, Calif.), D L Jassby, and D E Post (Princeton University, Princeton, NJ). In Heating in toroidal plasmas, Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978. Volume 1.

Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 13-18 16 refs. Research supported by the US Department of Energy.

The properties of deuterium plasmas in experimental tokamaks heated and fueled by intense neutral-beam injection are evaluated with a Fokker-Planck/radial transport code coupled with a Monte Carlo neutrals treatment. Illustrative results are presented for the Poloidal Divertor Experiment at PPPL as a function of beam power and plasma recycling coefficient,  $R_c$ . When beam power equals 8 MW at beam energy of 60 keV, and  $R_c$  equals 0.2, then the hot-ion/electron density ratio is about 0.5,  $2/3$  the mean ion energy equals 22 keV or about 6 times the mean electron temperature, and the D-D neutron intensity is 10 to the 16th n/sec.

(Author)

**A79-45004 #** Tearing mode instabilities and their suppression by lower hybrid fields. A K Sundaram (Physical Research Laboratory, Ahmedabad, India) and A C Das. In Heating in toroidal plasmas, Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978. Volume 1.

Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 177-180 7 refs.

The kinetic theory of tearing mode instabilities in the collisionless limit is reexamined incorporating properly the magnetic shear effects. An important feature of this analysis is the relaxation of constant  $A$  approximation usually invoked in the singular layers by earlier authors. It is found that the new effects drastically modify the growth rate characteristics. The stabilization of tearing modes by the localized lower hybrid fields which are present due to parametric heating schemes is also discussed briefly.

(Author)

**A79-45028 #** The theory of lower hybrid heating of tokamak plasmas. M Brambilla (EURATOM and Commissariat à l'Energie Atomique, Département de Physique du Plasma et de la Fusion Contrôlée, Grenoble, France). In Heating in toroidal plasmas, Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978. Volume 2.

Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 251-263 45 refs.

Aspects of the theory of lower hybrid resonance heating of tokamak plasmas which are important for the interpretation of recent experiments and for future applications in fusion research are discussed. Attention is given to the plasma model for the description of lower hybrid waves, a linear theory accounting for the 'Grill' (a waveguide array mounted on the liner), the electrostatic approach to resonance cones, and the hot plasma dispersion relation near the point where incoming cold plasma waves turn back along a warm plasma electrostatic branch. Implications of the theory for the design of heating antennas and waveguide arrays are considered. Theories of nonlinear effects arising during plasma heating, including self-induced scattering of lower hybrid resonance waves, anomalous absorption and anomalous thermalization brought about by wave decay are also discussed. A.L.W.

**A79-45030 #** Lower hybrid heating experiments in JFT-2 tokamak. T. Nagashima and N. Fujisawa (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). In: Heating in toroidal plasmas; Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978, Volume 2. Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 281-292, 16 refs.

Preliminary results of lower-hybrid heating studies conducted with the JFT 2 tokamak using a hydrogen plasma are presented. A phased array of four waveguides was used for power coupling; experiments were carried out with RF power levels up to 135 kW applied for 20 seconds. A transmission efficiency of 90 percent was obtained. The coupling characteristic of the array was found to be well predicted by the Brambilla (1976) calculations. Parametric instability occurred in the vicinity of the plasma edge in front of the launcher. Effective ion heating of 50 to 60 percent has been obtained, but no indication of electron heating or production of superthermal electrons has been found. C.K.D.

**A79-45033 #** Electron cyclotron heating in Bumpy Torus Program. H. Ikegami (Nagoya University, Nagoya, Japan) and R. A. Dandl (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Heating in toroidal plasmas, Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978, Volume 2. Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 321-337, 45 refs. ERDA-sponsored research.

Electron cyclotron heating is reviewed from the viewpoint of experiments on the Elmo Bumpy Torus. Consideration is given to some of the coupling processes of microwave power to plasmas and the generation of energetic electrons which is explained as a distinguishing feature of microwave discharge plasmas in the bumpy torus configuration. Some discussion is made on the technology for the successful application of high-power millimeter microwaves to the heating of fusion plasmas. In Appendix, experimental results are presented from the Elmo Bumpy Torus. (Author)

**A79-45034 #** Gyrotrons for the electron-cyclotron plasma heating in large tokamaks. V. V. Alikaev, V. A. Flagin, V. I. Khizhniak, A. G. Luchinin, G. S. Nusinovich, V. G. Usov, and S. N. Vlasov (Akademiia Nauk SSSR, Institut Prikladnoi Fiziki, Gorki, USSR). In: Heating in toroidal plasmas, Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978, Volume 2. Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 339-349, 7 refs.

Gyrotrons which use the electron-cyclotron resonance (ECR) to obtain high-frequency oscillations for plasma heating in large tokamaks are considered. These devices are cyclotron resonance masers (CRM) which use electron cyclotron emission, with particle bunching caused by the relativistic dependence of the cyclotron frequency of electrons on their energy. The characteristic feature of the gyrotron is its operation on the modes excited at the frequency close to the cut-off frequency in a part of the waveguide employed as a resonator. Generators for the electron cyclotron plasma heating

and the output power of a gyrotron are discussed, noting that the beam current can be raised due to the increase in the current density and in the cross-section of the tube-shaped electron beam. The long pulse gyrotron with large resonator, collector, and output window is discussed, and the microwave complex requirements including the wave-vector angle, location of the focus, and the angle between the directions of tokamak magnetic field and microwave emission are described. A.T.

**A79-45037 #** Heating of current-free stellarators. J. L. Shohet (Wisconsin, University, Madison, Wis.). In: Heating in toroidal plasmas; Proceedings of the Joint Varenna-Grenoble International Symposium, Grenoble, France, July 3-7, 1978, Volume 2. Grenoble, France, EURATOM and Commissariat à l'Energie Atomique, 1978, p. 377-388, 13 refs. NSF Grant No. ENG-77-14820.

Recent results from large stellarator experiments have shown that current-free operation may be the optimum mode of operation for these devices. RF heating has provided good heating efficiency. Neutral beam heating may be effective provided enhanced transport due to helical ripples is not significant. (Author)

**A79-45154** An optical valve for flat-plate solar energy collectors. K. S. Kohli, K. N. Chopra, and R. Hradaynath (Instruments Research and Development Establishment, Dehra Dun, India). *Journal of Optics*, vol. 10, July-Aug. 1979, p. 195, 196, 11 refs.

An optical valve for use in flat-plate solar energy collectors is described. A small optical wedge made of a high-transmission dielectric material is placed between the reflecting surfaces of adjacent triangular reflectors. The wedge is in the form of an isosceles triangle; part of its two equal sides is coated with a highly reflecting material. The wedge reflects the incident solar radiation falling on the coated portions of the large surfaces and transmits incident radiation falling on the short side. This design doubles the angle of acceptance of the optical valve, resulting in an increase in the effective active time of the flat plate collector. C.K.D.

**A79-45201 \*** Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Conference sponsored by the University of Alabama, NASA, Alabama Solar Energy Association, et al. Edited by S. T. Wu, D. L. Christensen, and R. R. Head (Alabama, University, Huntsville, Ala.). Huntsville, Ala., UAH Press, 1978, 504 p. \$25.

Demonstration projects, systems-subsystems simulation programs, applications (heating, cooling, agricultural, industrial), and climatic data testing (standards, economics, institutional) are the topics of the book. Economics of preheating water for commercial use and collecting, processing, and dissemination of data for the national demonstration program are discussed. Computer simulation of a solar energy system and graphical representation of solar collector performance are considered. Attention is given to solar driven heat pumps, solar cooling equipment, hybrid passive/active solar systems, and solar farm buildings. Evaluation of a thermographic scanning device for solar energy and conservation applications, use of meteorological data in system evaluation, and biomass conversion potential are presented. V.T.

**A79-45202** Overview of solar energy programs and activities in the Southeast. D. L. Christensen (Alabama, University, Huntsville, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978, Huntsville, Ala., UAH Press, 1978, p. 3-9.

Climatic factors, heating and cooling programs, test and research sites, and advanced solar energy technologies are discussed. Attention is given to costs, industrial factors, and industrial and commercialization factors. The longer-term and more sophisticated solar energy technologies, such as wind, ocean-thermal, solar-thermal, and photovoltaics are evaluated. One of the largest wind machines will be

installed in the North Carolina mountains Biomass conversion is another logical consideration for the Southeast as available sunshine and water are important factors for this type of energy resource. Such activities as broad use of solar energy for heating water, improved design concepts for building and solar equipment, mass production of modular and packaged heating and cooling units are considered as critical to the more widespread application of solar energy in the Southeast V T.

**A79-45203** Southern regional solar energy center planning. G B Graves (Southern Solar Energy Planning Projects, Atlanta, Ga). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 11-22 Contract No EM-78-L-01-4144

The objective of the southern regional solar energy planning project is to provide both an organizational structure and a work program that can be effective in developing and transferring solar technologies to use in concert with overall national energy policies. The project identifies and develops an initial work program on the following activities solar technology assessment and transfer, information dissemination, commercialization, development, application, and demonstration projects to suit regional situations, education and training programs, and coordination with national, state, and local elements. Cooling techniques, biomass conversion, energy requirements for crop drying, heat pump technologies, and ocean thermal energy conversion are the main issues of the planning project together with socioeconomic and institutional problems V T.

**A79-45204** Solar radiation data in the southeastern United States. E A Carter and B B Williams (Alabama, University, Huntsville, Ala). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 31-42 9 refs

Proper selection of sites, sensors, data collection equipment, and correct installation and maintenance of equipment are necessary for meaningful solar radiation measurements. Some of these factors in reference to global, direct, and diffuse radiation are discussed briefly, and the relation of these measurements to tilt measurements is illustrated. The availability of solar radiation measurements in the southeastern United States is presented. The location of solar radiation sites, the data bank locations and format of data storage are given. (Author)

**A79-45205 \*** A comprehensive solar energy system analysis data base in Huntsville, Alabama. J P Goddard (Alabama, University, Huntsville, Ala). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 43-52. 6 refs. Research supported by the U S Department of Energy, Contract No. NAS8-31293

The history of a comprehensive solar energy system analysis data base developed by NASA/Marshall Space Flight Center and the University of Alabama is presented, along with its current status. The Marshall Information Retrieval and Data Storage (MIRADS) system was chosen for the data base, and feedback systems were arranged to cope with changes in the needs of the program management for the type of data gathered. The final structure of the data base consists of 22 files divided into 6 topical sections: summaries, climatological, utility rates, architectural, equipment, and economics. The data base offers help to the solar industry in two ways: it provides information and it serves as a model for users trying to establish the climatic and socioeconomic variables they should take into account when they examine a potential market for solar energy equipment V T.

**A79-45206** Economics of preheating water for commercial use. G T White (Whiteline, Inc., Asheville, N C). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 57-60

Concentrating collector panels (440 square feet) are being used to preheat water for a community cafeteria. The system has been under operation 10 months as of March, 1978, resulting in a savings of 21,376 kWh or a projected savings of 25,605 kWh per year. The clearness factor during this period of operation averaged 50.2% according to U S. Weather Bureau figures. Since the annual clearness factor in Asheville is 58%, a savings of  $58/50 \times 25,605 = 29,702$  kWh have been projected for a normal year. With a nominal collection area of 440 square feet, this results in a savings of 67.3 kWh per square foot per year. The cost of installation was approximately \$7,300.00. At \$0.03 per kWh, the savings amounted to \$888.00 per year or 12.2% on the cost of the investment without consideration of tax benefits. (Author)

**A79-45207** Feasibility of retrofitting health care and correctional institutions in Florida with solar water heating systems. R D Evans and R D. Doering (Florida Technological University, Orlando, Fla). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 61-73. 7 refs. Research supported by the Florida State Department of Administration

**A79-45208 \*** Collection, processing and dissemination of data for the national solar demonstration program. R E Day, L J Murphy, and J T Smok (IBM Corp., Federal System Div., Huntsville, Ala). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 75-83. Contracts No. NAS8-32036, No. EG-77-C-01-4049

A national solar data system developed for the DOE by IBM provides for automatic gathering, conversion, transfer, and analysis of demonstration site data. NASA requirements for this system include providing solar site hardware, engineering, data collection, and analysis. The specific tasks include: (1) solar energy system design/integration, (2) developing a site data acquisition subsystem, (3) developing a central data processing system, (4) operating the test facility at Marshall Space Flight Center, (5) collecting and analyzing data. The systematic analysis and evaluation of the data from the National Solar Data System is reflected in a monthly performance report and a solar energy system performance evaluation report V T.

**A79-45209** Solar 'plus' - Huntsville, Alabama. R E Somers (Remtech, Inc., Huntsville, Ala). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 85-94. 8 refs

The design, construction, and performance of a solar house built with standard equipment in Huntsville, Alabama, is described. The solar system was designed to provide domestic hot water and space heating for a family of five occupying the 2287 sq ft residence. The system uses ten high-temperature liquid, flat-plate collectors and a 500-gallon thermal storage tank to provide an estimated 63% of the annual load. The storage subsystem is in series with the collector array and the distribution subsystem so that the system is basically three independent flow loops. During construction the house was insulated to almost twice the R-values required by the local code and attention was given to caulking and weather-stripping windows and doors V T.

**A79-45210** Application of system design techniques to a solar domestic hot water retrofit and an 87 unit apartment complex. J Greenstein and J L Lipeles (Aztec Solar Co., Maitland, Fla.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala, April 17-19, 1978 Huntsville, Ala, UAH Press, 1978, p 95-107

**A79-45211** A review of current R&D in thermal energy storage and heat exchange in solar applications. A I Michaels (Argonne National Laboratory, Argonne, Ill). In Application of

solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 131-143 31 refs Research supported by the U. S. Department of Energy.

The paper reviews the state of advanced technology by presenting a survey of current research and development underway in all of the media and methods used for storing and transferring thermal energy. The thermal energy storage and heat transfer methods discussed are innovative heat exchange and transport, advanced concept sensible heat storage in water, rock, earth or a combination of these, for either short term or for annual storage periods, heat storage in the energy of phase change, and heat storage in the energy of reversible chemical reactions. The material presented is organized in terms of the above categories and subcategories, with the specific R&D projects listed (Author)

**A79-45212 \*** Evaluation of Rankine cycle air conditioning system hardware by computer simulation. H. M. Healey (Western Kentucky University, Bowling Green, Ky.) and D. Clark (NASA, Marshall Space Flight Center, Huntsville, Ala.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 145-163 7 refs.

A computer program for simulating the performance of a variety of solar powered Rankine cycle air conditioning system components (RCACS) has been developed. The computer program models actual equipment by developing performance maps from manufacturers data and is capable of simulating off-design operation of the RCACS components. The program designed to be a subroutine of the Marshall Space Flight Center (MSFC) Solar Energy System Analysis Computer Program 'SOLRAD', is a complete package suitable for use by an occasional computer user in developing performance maps of heating, ventilation and air conditioning components (Author)

**A79-45213** Computer simulation of a solar energy system with a viscous-entrainment liquid storage tank model. S. M. Han and S. T. Wu (Alabama, University, Huntsville, Ala.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 165-183 12 refs Contract No. EG-77-S-02-4479

Existing models for the liquid solar energy storage system do not properly consider viscous entrainment effects of jet streams which cause turbulent mixing inside liquid storage tanks. Turbulent mixing reduces thermal stratification adjacent to jet streams and prevents jet streams from going further down to the bottom of the storage tank. To account for viscous entrainment effects, a set of partial differential equations is derived and an implicit finite difference method is employed for its solution. TRNSYS solar energy simulation with this viscous-entrainment liquid storage model is carried out for a hot water application. Simulation results show that the viscous entrainment model represents more realistic storage tank performance compared with other existing models (Author)

**A79-45214** Three dimensional mathematical model of flow stratification in thermocline storage tanks. W. T. Sha and E. I. H. Lin (Argonne National Laboratory, Argonne, Ill.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 185-202 11 refs Research sponsored by the U. S. Department of Energy

A three-dimensional, transient, single-fluid, single-phase mathematical model, the COMMIX-SA computer program, is being developed to investigate the flow stratification phenomena that occur in thermocline storage tanks, and the effects of stratification on solar systems performance. The model solves the conservation equations of mass, momentum, and energy as an initial value problem in time and a boundary value problem in space. Details on the formulation of the model and the numerical techniques employed are described, and special features of the model are discussed. The model has been used to analyze several storage-tank stratification problems. The results indicate that the model is capable

of predicting realistically the flow and temperature distributions in storage tanks. The predictions are in good qualitative agreement with experiments and show substantial improvement over those obtained by the TRNSYS one-dimensional model. Three-dimensional effects are evident, and some parametric studies are suggested (Author)

**A79-45215** Heat storage in crushed limestone. B. F. Parker, C. D. Arnold, G. M. White, and O. J. Loewer, Jr. (Kentucky, University, Lexington, Ky.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 203-212. 8 refs Research sponsored by the U. S. Department of Energy and U. S. Department of Agriculture

The problems and potentials for using crushed limestone as a thermal energy storage medium are discussed. Characteristics of a rock bed thermal storage unit, such as the heat transfer rate between air and the stone, the pressure required to force air through the bed, and a heat capacity, are considered together with flow and cleanliness problems which might be created by dust, lint, and moisture in the bed. To minimize the problem of lint and dust, the air entering the rock bed should be filtered in addition to protection from moisture with a gravity drain. A balance between the pressure drop and the rate of heat transfer between air and the stone is needed, therefore, the smallest stone size consistent with reasonable pumping efficiency should be selected. V. T.

**A79-45216** Graphical representation of solar collector performance. H. G. Paul (Alabama, University, Huntsville, Ala.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 233-240 7 refs

Determination of the thermal performance of solar collector modules by test according to ASHRAE Standard 93-77 involves a number of variables, such as incident solar radiation, ambient temperature, fluid inlet and exit temperatures and mass flow across the collector. A diagram arrangement is presented which elucidates the roles of these variables as to efficiency and useful energy output of the collector over an ample operational range. A blank quadrant is provided which allows incorporation of the straight-line or other thermal efficiency curve of collectors for comparison, extrapolation or analysis. The graphical method presented should greatly facilitate the interpretation of the ASHRAE Standard 93-77 recommended Hottel-Whillier-Bliss plot of the measured thermal performance of solar energy collector modules. (Author)

**A79-45217 \*** Protection of solar collector materials from UV. J. G. Castle, Jr. (Alabama, University, Huntsville, Ala.), R. L. Gause, and A. Whitaker (NASA, Marshall Space Flight Center, Materials and Processes Laboratory, Huntsville, Ala.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 241-245

Certain plastic films, such as KAPTON, are known to be stable with excellent long-term aging characteristics under intense uv radiation. Our recent measurements of the optical transmission spectra of KAPTON films show an absorption edge in the blue and are interpreted in terms of an electronic excitation mechanism. The application of this type of film as covering for solar collectors is discussed in regard to the protection this strong uv absorption offers to the materials underneath (Author)

**A79-45218 \*** Early developments in solar cooling equipment. J. M. Price (NASA, Marshall Space Flight Center, Solar Heating and Cooling Projects Office, Huntsville, Ala.). In Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978 Huntsville, Ala., UAH Press, 1978, p. 249-252

A brief description of a development program to design, fabricate and field test a series of solar operated or driven cooling devices, undertaken by the Marshall Space Flight Center in the context of the Solar Heating and Cooling Demonstration Act of

1974, is presented. Attention is given to two basic design concepts: the Rankine cycle principle and the use of a desiccant for cooling

C.K.D

**A79-45219 \*** **Solar-powered Rankine heat pump for heating and cooling.** J. Rousseau (AirResearch Manufacturing Company of California, Torrance, Calif.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Huntsville, Ala., UAH Press, 1978, p. 253-267. Contract No. NAS8-32091

The design, operation and performance of a family of solar heating and cooling systems are discussed. The systems feature a reversible heat pump operating with R-11 as the working fluid and using a motor-driven centrifugal compressor. In the cooling mode, solar energy provides the heat source for a Rankine power loop. The system is operational with heat source temperatures ranging from 155 to 220 F; the estimated coefficient of performance is 0.7. In the heating mode, the vapor-cycle heat pump processes solar energy collected at low temperatures (40 to 80 F). The speed of the compressor can be adjusted so that the heat pump capacity matches the load, allowing a seasonal coefficient of performance of about 8 to be attained.

C.K.D.

**A79-45220** **Review report on the solar heating/cooling operational test site at Stouffer Place Building Number 1, Kansas University, Lawrence, Kansas.** S. E. Scarborough (Honeywell, Inc., Minneapolis, Minn.), W. D. Batton (Barber-Nichols Engineering Co., Arvada, Colo.), and B. Dollars (Lennox Industries, Carrollton, Tex.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 269-288.

The status of a program undertaken to develop solar-powered Rankine engine/air conditioner systems is discussed. The program calls for the development of a residential heating system, a residential cooling/heating system, a 25-ton multi-family heating/cooling system, and commercial heating/cooling systems in 25-, 50-, and 75-ton versions. At present, one residential unit is operational, one under construction, and the remaining systems are at various stages of design. A description of the design and operation of the multi-family unit is provided.

C.K.D.

**A78-45221** **Rankine cycle solar driven heat pump development.** J. C. Graf (General Electric Co., Philadelphia, Pa.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 289-298.

The characteristics of two Rankine cycle solar driven heat pumps currently under development for projected introduction in the mid-1980s are described. The systems, intended to provide central air conditioning for residential applications, are being developed in three- and ten-ton versions. A single-compressor, aircooled concept using a fluorocarbon working fluid has been adopted. A high-efficiency, vertically mounted two-stage expander is under development.

C K D

**A79-45222** **The HYCSOS solar energy driven heat pump.** I. Sheft, D. Gruen, and G. Lamich (Argonne National Laboratory, Argonne, Ill.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 299-308. 5

refs

The HYCSOS solar energy driven chemical heat pump is described, and operational experience obtained with a demonstration test facility is discussed. The system, based on a two-hydride (CaNi<sub>5</sub> and LaNi<sub>5</sub>) concept, can function in heating, cooling and energy conversion modes, and can significantly reduce the required area of solar collectors.

C K.D.

**A79-45223** **Instrumenting hybrid passive/active solar systems.** W. W. Youngblood and J. C. Gray (Northrop Services, Inc., Huntsville, Ala.). In: Application of solar energy, Proceedings of the

Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 309-324. 9

refs.

A set of recommendations are provided for instrumenting and reporting the performance of hybrid passive/active solar heating systems. The discussion centers on the entire system/subsystem/site combination and attempts to remove some of the uncertainties in providing sufficient data for adequate performance evaluations of such systems. The major subject of this paper concerns solar heating systems utilizing massive thermal storage that is also a portion of the building structure and that is architecturally integrated into the building esthetically. The instrumentation recommended includes the conventional temperature sensors, flow meters, pressure sensors, radiation measurement devices, and relative humidity sensors, as well as some special instrumentation including mean radiation temperature sensors, passive wall thermal gradient sensors, and others. The use of these instruments will be discussed from the standpoint of what performance parameters they can aid in determining. (Author)

**A79-45224** **Solar farm buildings collect energy for crop drying.** G. C. Shove (Illinois, University, Urbana, Ill.). In: Application of solar energy: Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 325-331.

**A79-45225** **Use of meteorological data in system evaluation.** S. E. Taylor (Auburn University, Auburn, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 387-398. 9 refs.

The efficiency of a solar energy collection system is dependent on the solar energy absorbed and on the energy losses from the system primarily by radiation, convection, conduction. The method of estimating solar collector efficiency which has been suggested by the National Bureau of Standards is discussed. This method accounts for the meteorological parameters of insolation and air temperature; the detailed physical analysis also takes into account air speed and direction, evaporation or condensation of water on the collector surface, and thermal background radiation. A detailed physical analysis of the energy balance of a collector is presented and compared with the NBS's estimation method. Details on collection of meteorological data are given.

(Author)

**A79-45226** **On solar energy heating and degree days during the winter months.** O. M. Essenwanger (U.S. Army, Missile Research and Development Command, Redstone Arsenal, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., UAH Press, 1978, p. 399-417. 15 refs.

The performance of a solar heating system in a climatic region that has a series of consecutive cloudy days (in winter) is investigated. A method that associates the size of a collector area with the energy reserve capacity, based on climatological background that enables hardware factors to be added later, is described. The available solar energy and the corresponding heat requirements during two winters in Huntsville, Alabama, serve as a basis for developing the concept of computer modeling for the design of an optimum and nonfailing solar heating system. Attention is given to the design evaluation and the relationship between degree days and solar energy. It is concluded that a solar heating system based on an expectation of 140 Langley's per day and 11 days of storage capacity would have been sufficient to supply a home with the necessary heat, however an alternate system based on the average January solar radiation, would have required 27 days worth of an alternate heat source.

C.F.W.

**A79-45227** **The economics of solar domestic hot water systems in state university and community college buildings.** R. D. Doering and R. D. Evans (Florida Technological University, Orlando,

Fla) In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978.

Huntsville, Ala., 1978, p. 427-437. 5 refs. Research supported by the Florida State Department of Administration.

**A79-45228** Low cost selective surface-carbon particle coating. J. Lents (Energy Converters, Inc., Chattanooga, Tenn.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Huntsville, Ala., UAH Press, 1978, p. 439-443.

In measuring and comparing various coatings for metal absorber plates, it was observed that a coating of carbon microspheres produced higher solar collection rates than normal painted coatings. Test plates were coated with different densities of carbon microspheres and tests were made on these surfaces. These tests verified that carbon microspheres can be used to produce a moderately selective solar energy absorption surface. Absorption to relative emissivity ratios ( $\alpha/\epsilon$ ) of 2 to 3.2 could be produced with the carbon microspheres. When optimized for residential potable water heating an absorption of .99 with a consequent relative emissivity of .5 was found to be best. For summer air conditioning an absorption of .9 with a consequent relative emissivity of .3 was found to be optimum. Test results are shown along with the theory of operation to explain the selective properties of these surfaces. (Author)

**A79-45229** Evaluation of a thermographic scanning device for solar energy and conservation applications. D. L. Christensen (Alabama University, Huntsville, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Huntsville, Ala., UAH Press, 1978, p. 445-464. 5 refs.

Electronic thermography is the term associated with a group of IR imaging systems that use some intermediate means of converting changes in IR radiation into a visual display. The paper is concerned with a thermal imaging system, the Magnavox An/PAS-7 Point Detector/scanning Mirror handheld viewer, which was used for a series of evaluation tests during June 1977. This real-time IR imaging system is designed to provide detection and recognition of any object having a temperature difference, however slight, between it and its surroundings. The system operates in the 3-5-micron band of the IR spectrum and utilizes a 48-element thermoelectrically cooled lead selenide detector array. The viewer has a 6 by 6 deg field of view and weighs 6.5 lb without the battery pack. Testing activities, survey results, and areas of concern are discussed. S.D.

**A79-45230 \*** Collector testing in the MSFC simulator. W. S. Humphries (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Huntsville, Ala., UAH Press, 1978, p. 465-479.

The Marshall Space Flight Center (MSFC) Sun simulator and collector testing techniques are described herein. Details of simulator construction are given along with actual measured simulation performance characteristics. Initial comparative performance data from selected air and liquid collector tests are presented for both indoor simulator tests and outdoor tests. These data indicate exceptionally good collector efficiency correlations between the two tests. Comparisons prove sufficiently the validity of using the MSFC simulator for nonconcentration flat plate collector configuration performance evaluations. (Author)

**A79-45231** Biomass conversion potential in the Southeast. H. Saha (Alabama A & M University, Huntsville, Ala.). In: Application of solar energy, Proceedings of the Third Southeastern Conference, Huntsville, Ala., April 17-19, 1978. Huntsville, Ala., UAH Press, 1978, p. 481-488. 8 refs.

The biomass production and conversion potential of the southeastern U.S., with its large forest land and wood residue, long

coastal areas, abundance of water, large amounts of readily collectable agricultural, urban and industrial waste materials, longer rainfall and fertile soil, is examined. Various types of biomass production and conversion methods, including terrestrial and silvicultural biomass as well as herbaceous, aquatic and organic waste biomass, are evaluated. A result of a silvicultural biomass production found that its productivity under closed-space, short-rotation conditions could yield annual dry-ton-equivalents of 5 to 13 tons per acre. It was also determined that the most promising production of large quantities of biomass in the SE U.S. would be the establishment of intensively-managed energy farms, using woody and herbaceous species, including forest and crop residues, high-yield crops, and animal manure. Special attention is given to diagrams that describe biomass conversions, such as terrestrial biomass and domestic residue, and to a description of the basic steps in ethanol production from farm products. C.F.W.

**A79-45328 #** An analysis of operational procedures and design modifications for aircraft fuel conservation. R. Aggarwal, A. Dushman (Dynamics Research Corp., Wilmington, Mass.), and A. J. Calise (Drexel University, Philadelphia, Pa.). In: Atmospheric Flight Mechanics Conference for Future Space Systems, Boulder, Colo., August 6-8, 1979, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 232-242. 11 refs. (AIAA 79-1656)

This paper is taken from a two year study conducted to determine the effectiveness of fuel conservation measures as applied to Air Force bomber/transport type aircraft. The impact of various potential design and operational procedure improvements are quantified. A major contribution of this study is the approach taken to generate the effect of design changes on fuel consumption and direct operating cost (DOC). Sensitivity plots of fuel and DOC savings as a function of the design parameters are generated for each aircraft type. These plots are based on actual mission trajectory data as opposed to 'typical' mission trajectory profiles. (Author)

**A79-45479** Solid state electrodes for high energy batteries. D. W. Murphy (Bell Telephone Laboratories, Inc., Murray Hill, N.J.) and P. A. Christian. *Science*, vol. 205, Aug. 17, 1979, p. 651-656. 60 refs.

Candidate cathode materials for rechargeable batteries based on topochemical reactions of lithium and transition metal compounds are discussed. The reactions involved in intercalation are outlined, and reactions which serve to model the intercalation (discharge) and deintercalation (charge) reactions of the cathode are considered. Among the cathode materials examined are van der Waals bonded structures, three-dimensionally bonded host lattices, and Perovskite-based structures. C.K.D.

**A79-45500** The exergy of fuels (Die Exergie der Brennstoffe). H. D. Baehr (Hamburg, Hochschule der Bundeswehr, Hamburg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 31, July 1979, p. 292-297. 7 refs. In German.

Calculations of fuel exergy, dependent upon the enthalpy of fuel combustion, and exergy calculations for oxygen, nitrogen, water, carbon dioxide, and sulfur dioxide are examined. The effects of various environments on fuel exergy and its numerical analysis are discussed, and a model is sought where the requirement of thermodynamic theory coincides with the estimated expectations. The calculations involving fuel exergy are performed for thermal and mechanical equilibrium states. Results show that the exergy of fluid fuels lies at about 2%, while that of gaseous fuels is 4 to 7% less than the gross heating value. Overall it was determined that fuel exergy and total net caloric power rarely differ and thus the chemical bond energy is actually the total exergy in its energy equivalent form. C.F.W.

**A79-45531** Evolution of particles in the plumes of coal-fired power plants. I - Deductions from field measurements. P. V.

Hobbs, D A Hegg, M W Eltgroth, and L F. Radke (Washington, University, Seattle, Wash ) *Atmospheric Environment*, vol 13, no 7, 1979, p 935-951 20 refs Research supported by the Electric Power Research Institute

**A79-45532** Evolution of particles in the plumes of coal-fired power plants II - A numerical model and comparisons with field measurements. M W Eltgroth and P V Hobbs (Washington, University, Seattle, Wash ) *Atmospheric Environment*, vol 13, no 7, 1979, p 953-975 45 refs Research supported by the Electric Power Research Institute

**A79-45538** A study of long range air pollution problems related to coal development in the Northern Great Plains. D R Durran, M J Meldgin, M-K Liu (Systems Applications, Inc , San Rafael, Calif ), T Thoen (US Environmental Protection Agency, Denver, Colo ), and D Henderson *Atmospheric Environment*, vol 13, no 7, 1979, p 1021-1037 39 refs US Environmental Protection Agency Contract No 68-01-3591

**A79-45576** Hydrogen for energy distribution; Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978. Symposium sponsored by the Institute of Gas Technology Chicago, Institute of Gas Technology, 1979 682 p \$60

The symposium focused on hydrogen as an energy carrier analogous to electricity, covering its status today in the captive and merchant hydrogen industry to future uses, such as hydrogen-fueled transportation systems Specifically, papers covered hydrogen in the U S energy picture, international developments in hydrogen technologies, demand and supply as a chemical feedstock in U S , modern ammonia synthesis use of hydrogen, economics of small user hydrogen, developmental hydrogen via coal gasification processes, alkaline electrolysis, water electrolysis using polymer electrolytes, hydrogen via thermochemical and other advanced water-splitting technologies, transmission of gaseous hydrogen, and liquid hydrogen fueled commercial aircraft A T

**A79-45577 \*** Hydrogen in the U S energy picture. J H Kelley and R Manvi (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif ) In Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978 Chicago, Institute of Gas Technology, 1979, p 9-26 10 refs

A study of hydrogen in the U S program performed by the Hydrogen Energy Systems Technology (HEST) investigation is reported Historic production and use of hydrogen, hydrogen use projections, hydrogen supply, economics of hydrogen production and supply, and future research and development needs are discussed The study found current U S hydrogen utilization to be dominated by chemical and petroleum industries, and to represent 3% of total energy consumption Hydrogen uses are projected to grow by a factor of 5 to 20 during the remainder of this century, and new applications in synthetic fuel from coal manufacture and directly as energy storage or fuel are expected to develop The study concluded that development of new methods of supplying hydrogen replacing natural gas and petroleum feedstocks with alternate sources such as coal and heavy oils, and electrolysis techniques is imperative A T

**A79-45578** Role of hydrogen in Eco Energy. W Hausz (GE Center for Advanced Studies, Santa Barbara, Calif ) In Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978 Chicago, Institute of Gas Technology, 1979, p. 27-39 9 refs

A retrospective of GE-TEMPO's Eco Energy project, started in 1971, is described to show how an early interest in hydrogen as a clean energy form for economic distribution by underground pipelines developed into a conviction that a multiple media energy system was required The key components of the system, recognized

as needing technological breakthroughs, and the approaches to these breakthroughs being explored, are described It is concluded that hydrogen has a role in such a system, which may be minor or major depending on the technology and economics of the alternatives (Author)

**A79-45579** International developments in hydrogen technologies. G E Beghi (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy) In Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978 Chicago, Institute of Gas Technology, 1979, p 41-57

International cooperation in the research for new hydrogen production methods is reported Research areas in hydrogen production and utilization and the International Energy Agency programs on hydrogen production from thermal decomposition of sulfuric acid, thermal decomposition of metal sulfate, hydrolysis of FeCl<sub>2</sub>, liquid separation of H<sub>2</sub>SO<sub>4</sub>/HI from solution, decomposition of HI, decomposition of FeCl<sub>3</sub>, and production of hydrogen from water are discussed Other joint programs include thermochemical and electrolytic production, and transportation and storage of hydrogen It is expected that as a result of cooperative actions, it will be possible to conduct integrated experimental activities, exchange of researchers, and joint participation in pilot scale and demonstration projects A T

**A79-45580 \*** Demand and supply of hydrogen as chemical feedstock in USA. C J Huang (Houston, University, Houston, Tex ), K Tang, J H Kelley (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif ), and B J Berger (US Department of Energy, Washington, DC ) In Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978 Chicago, Institute of Gas Technology, 1979, p 69-84 13 refs Research supported by the US Department of Energy

Projections are made for the demand and supply of hydrogen as chemical feedstock in USA Industrial sectors considered are petroleum refining, ammonia synthesis, methanol production, isocyanate manufacture, edible oil processing, coal liquefaction, fuel cell electricity generation, and direct iron reduction Presently, almost all the hydrogen required is produced by reforming of natural gas or petroleum fractions Specific needs and emphases are recommended for future research and development to produce hydrogen from other sources to meet the requirements of these industrial sectors The data and the recommendations summarized in this paper are based on the Workshop 'Supply and Demand of Hydrogen as Chemical Feedstock' held at the University of Houston on December 12-14, 1977 (Author)

**A79-45581** Modern ammonia synthesis use of hydrogen T A Czuppon, A E Cover, and L J Buividas (Pullman Kellogg, Houston, Tex ). In Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill , July 24-28, 1978 Chicago, Institute of Gas Technology, 1979, p 111-137 12 refs.

The sources of hydrogen for ammonia production, the energy requirement of a modern ammonia plant and how it relates to the U S energy demand, the economics of alternate feedstocks, and the implications of natural gas scarcity are considered Raw materials for ammonia production, economics of raw materials, ammonia process hydrogen feed requirement, feed loss in steam reforming process, fuel requirement, and ammonia industry related to U S. energy demand are discussed Economics of alternate feedstocks, including natural gas, naphtha, heavy oil feeds, and coal are described It is concluded that if the cost of natural gas approaches \$3.00/mm Btu other feedstocks, such as heavy oil and coal, may be given consideration The outlook for the ammonia industry, their energy consumption, and future sources of synthesis gas are considered A T



**A79-45582** **Commodity hydrogen production and marketing** J E Johnson (Union Carbide Corp., New York, N.Y.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 147-161

The development of hydrogen technologies and their current status is presented. Today hydrogen is produced primarily for chemical synthesis and fuel uses are minor. On weight basis hydrogen production is less than one percent of liquid and gaseous fuels, and hydrogen delivered to users from central production facilities amounts to less than one percent of all hydrogen production. Location of liquid hydrogen supply and demand, industrial applications of hydrogen, including electronics, heat treatment, edible oil manufacture, and ammonia, methanol, and petroleum refining are discussed. It is concluded that new energy precursor large scale hydrogen processing technologies, not dependent on hydrocarbons, will be the next step toward energy applications for hydrogen. A T

**A79-45583** **Economics of small user hydrogen.** H G Corneil, F J Heinzlmann, and E W S Nicholson (Exxon Research and Engineering Co., Linden, N.J.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 163-174 4 refs

The future requirements for small user hydrogen and predicted costs of hydrogen during the 1980 to 2000 period are presented. Small user hydrogen includes small uses such as chemical synthesis, metallurgical processing, electronic manufacturing, and vegetable oil processing. Hydrogen requirements for this category totals 250 million SCFD and is expected to increase to 700 million SCFD by the year 2000. The key economic factor in obtaining hydrogen is the quantity needed. In the very small range of 1000 to 10,000 SCFD, the cost will vary from \$100 to \$35 per million Btu, depending on the users consumption rate, and delivery distance. For large quantities from 1 to 100 million SCFD on site manufacture is preferred with costs varying from \$10 to \$6 per MBtu. In the intermediate range of 100,000 to 1 million SCFD the user should compare on site manufacture by reforming, by electrolysis, and over the fence purchase from a nearby large producer. In this range hydrogen costs could vary from \$35 to \$10 per MBtu. A T

**A79-45585** **Hydrogen/oxygen steam generation - An example of aerospace technology transfer** D E Wright (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 193-223

A three-part technical study was conducted whereby parametric technical and economic feasibility data were developed on several power conversion systems suitable for the generation of central station electric power through the combustion of hydrogen and the use of the resulting heat energy in turbogenerator equipment. The study assessed potential applications of hydrogen-fueled power conversion systems and identified the three most promising candidates: (1) Ericsson Cycle, (2) gas turbine, and (3) direct steam injection system for fossil fuel as well as nuclear powerplants. A technical and economic evaluation was performed on the three systems from which the direct injection system (fossil fuel only) was selected for a preliminary conceptual design of an integrated hydrogen-fired power conversion system. (Author)

**A79-45586** **Hydrogen production via the K-T gas gasification process - Current economic and technological aspects.** H J Michaels (Koppers Co., Inc., Pittsburgh, Pa.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 225-238

Technological and economic aspects of hydrogen production by the K-T gas gasification process are presented. The process converts carbonaceous feedstock into a raw gas containing principally carbon monoxide and hydrogen by partial oxidation, and it entails the

reaction of a carbon containing feedstock with oxygen and steam at high temperatures in an entrained bed type of gasification system. The syngas produced can be used as a fuel gas or can be upgraded to hydrogen or synthetic natural gas. The process can handle a variety of feedstocks, including coal, char, and coke, and it produces no tars, phenols, or condensable hydrocarbons. The cost of producing 100 million SCFD of 97.4% pure hydrogen with less than 10 ppm carbon oxide is \$4.50 to \$7.00 per million Btu. The sensitivity of hydrogen costs to feedstock costs, plant site, and financing methods is discussed. A T

**A79-45587** **Developmental hydrogen via coal gasification processes.** P. B. Tarman (Institute of Gas Technology, Chicago, Ill.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 239-252

Commercially available and developmental technologies for producing hydrogen from coal are summarized. The Winkler process operates as a fluidized bed and uses noncaking coals, the Koppers-Totzek process operates as an entrained bed and can use any coal type, the Lurgi process uses a moving bed and noncaking coals, and the Wellman-Galusha process utilizes a fixed bed gasifier at near atmospheric pressure and temperatures of 1000 to 2000 F. The new technologies include the Texaco process using partial oxidation of coal with steam and oxygen at elevated pressure, the U-Gas process based on single stage, nonslagging, fluidized bed, the steam-iron process using air instead of oxygen and producing large amounts of electrical power in addition to high-purity hydrogen. It is concluded that as the demand for hydrogen increases a wide choice of processes for producing high purity hydrogen from coal will be available. A T

**A79-45588** **Alkaline electrolysis - Past, present and future.** W C Kincaide and M P Saltzman (Teledyne, Inc., Timonium, Md.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 267-287 7 refs

Background of hydrogen production by water electrolysis, the current state of the art, and development of large plant sized units are presented. The alkaline electrolysis process is described, noting that its applications required high purity gas and had low cost electricity available. Alkaline technology including unipolar and bipolar cell construction and pressure requirements are discussed. Development of a plant sized electrolysis system capable of producing 1 to 2 ton per day of hydrogen is outlined, along with the description of the prototype version of the plant. An advanced materials development program is investigating plumbing corrosion, cell frame stability, and electrode separator stability in a gas generating system designed for cell voltage studies at current densities up to 2500 ma/sq cm, voltages up to 3.6 volt/cell, and temperatures up to 300 F in a five cell bipolar module. A T

**A79-45589** **Water electrolysis using solid polymer electrolytes.** L J Nuttall (General Electric Co., Wilmington, Mass.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978* Chicago, Institute of Gas Technology, 1979, p 289-305

The Solid Polymer Electrolyte (SPE) electrochemical technology for hydrogen generation is presented. This water electrolysis method was originally developed for oxygen generation for manned spacecraft and submarine life support systems, and with the availability of new anode catalysts which provide more efficient oxygen evolution in conjunction with acidic electrolytes, the SPE has shown a breakthrough in efficiency and cost for water electrolysis systems. SPE technology including chemistry, cell construction, cell voltage, current density, and the advantages of the SPE cell over other types of cells, such as highest efficiency, electrolyte stability, and ability to withstand high differential pressures, are discussed. A development program to produce a large-scale SPE electrolysis design for bulk hydrogen generation which started with a design study of a 58 MW system, and is directed towards low-cost materials for



separators and current collectors, use of lower cost catalyst and lower cost electrolyte, operation at higher temperature, and improved electrodes, is described. A 50 kW module was designed and is being fabricated, and its 12 cells have an active area of 2-1/2 sq ft, featuring pneumatically loaded end plates for uniform compression

A T.

**A79-45590**      **Hydrogen via thermochemical and other advanced water-splitting technologies.** J B Pangborn (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen for energy distribution; Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p.

307-316 17 refs

Research on the production of hydrogen from water and nonfossil energy sources using thermophotocatalytic, biochemical, and hybrid processes is presented: Direct thermal splitting of water, multistep thermochemical cycles, hybrid cycles with the reaction steps driven by work inputs from an electrochemical or electrolysis step, and steam-iron processes continuously producing hydrogen from char are discussed. Future technology processes include nuclear radiolysis, digestion of biomass, photosynthetic and biochemical hydrogen production, and hydrogen production in a photochemical cell. It is concluded that thermochemical production is laboratory-proved in noncontinuous procedures, but most methods require solar or geothermal heat, or high-temperature, gas-cooled reactors if nuclear heat is the energy source. High-temperature heat is acknowledged as a requirement for efficient operation of thermochemical processes.

A.T.

**A79-45591**      **The Westinghouse Sulfur Cycle Hydrogen Production Process.** G H Farberman (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p. 317-337

The Sulfur Cycle Hydrogen Production Process is a hybrid electrochemical/thermochemical process for decomposing water into hydrogen and oxygen. The development program is based on the desire to have a process development unit (PDU) operating at the pressures, temperatures, and performance levels desired for a commercial unit in service by 1983. The program required to meet the schedule and the results of the development activities performed to date are discussed. Evaluations of process performance and economics for both nuclear and nonnuclear energized process configurations continue to show overall thermal efficiencies of close to 50 percent and potential economics competitive with alternate methods of producing bulk hydrogen.

(Author)

**A79-45592 \***      **Dedicated nuclear facilities for electrolytic hydrogen production.** S E Foh, W J D Escher, and T D. Donakowski (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p. 339-359. 22 refs. NASA-supported research.

An advanced technology, fully dedicated nuclear-electrolytic hydrogen production facility is presented. This plant will produce hydrogen and oxygen only and no electrical power will be generated for off-plant use. The conceptual design was based on hydrogen production to fill a pipeline at 1000 psi and a 3000 MW nuclear base, and the base-line facility nuclear-to-shaftpower and shaftpower-to-electricity subsystems, the water treatment subsystem, electricity-to-hydrogen subsystem, hydrogen compression, efficiency, and hydrogen production cost are discussed. The final conceptual design integrates a 3000 MWth high-temperature gas-cooled reactor operating at 980 C helium reactor-out temperature, direct dc electricity generation via acyclic generators, and high-current density, high-pressure electrolyzers based on the solid polymer electrolyte approach. All subsystems are close-coupled and optimally interfaced and pipeline hydrogen is produced at 1000 psi. Hydrogen costs were about half of the conventional nuclear electrolysis process.

A T.

**A79-45593 \***      **Concepts for solar production of hydrogen.** J A. Hanson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p.

361-392. 24 refs.

Some basic technical approaches to producing hydrogen from solar energy are surveyed. Solar energy forms are divided into (1) direct solar radiation and (2) indirect forms such as wind and ocean thermal gradient. Technical approaches are separated into (1) direct hydrogen production from the action of sunlight on some substrate, (2) hydrogen production from sunlight via an intermediate form of energy such as heat and electricity, and (3) hydrogen production from indirect solar energy via an intermediate energy form. It is concluded that while hydrogen from solar energy will be expensive by present standards, the depletion of fossil fuels will cause solar hydrogen to emerge as one of the few alternatives to a nuclear-electric or nuclear-electric-hydrogen energy system.

M E P

**A79-45594**      **Hydrogen from falling water.** J Palumbo (Pennsylvania Gas and Water Co., Pa.). In: Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p. 393-398. 8 refs.

Over the past years, with ever rising energy costs, the United States has looked at the possibility of harnessing existing untapped dams for energy conversion purposes. However, integration of these facilities into the conventional electric utility systems has not occurred due to technical, economic, and institutional difficulties, the key issues being the seasonal unreliability of water flow, the regulatory status of small operators desiring to sell power, and the possibility of large investments with low rates of return. The present analysis indicates that, in spite of constituting a small fraction of the United States energy demand, this overall 'small hydro' energy resource base should be utilized to its fullest potential.

V P

**A79-45595**      **Hydrogen and alternative means of energy delivery from ocean thermal energy conversion (OTEC) plants.** A Talib, A. Konopka, N Biederman, C Blazek, and B Yudow (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen for energy distribution; Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p. 399-423. 25 refs. NSF Grants No. NSF-C-1008, Grant No. AER-75-00033, Contract No. E(49-18)-2426

In the present paper, a concise technical assessment and economic analysis are made of components associated with the conversion, storage, transportation, and shore-based receiving facilities for the conversion of OTEC mechanical energy to chemical energy and, in some cases, conversion of delivered chemical energy to electricity. Particular attention is given to the equipment, capital and operating costs, and efficiencies of converting the delivered hydrogen and ammonia into electricity.

V P

**A79-45597**      **Transmission of gaseous hydrogen - A preliminary technology evaluation.** S L Robinson (Sandia Laboratories, Livermore, Calif.). In: Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978. Chicago, Institute of Gas Technology, 1979, p. 453-483. 34 refs. Contract No. HC-01-07-03

Hydrogen embrittlement phenomena are discussed, and their implications for hydrogen transmission by pipeline are explored. Metallurgical trends in pipe steels are considered for their effect on hydrogen embrittlement. Burst testing of internally flawed A106-B pipe showed a 15% loss in hoop stress at failure when pressurized with 1000 psi hydrogen. Therefore, pressure derating of pipelines for hydrogen transmission compared to natural gas may be necessary for equivalent safety margins. Fracture toughness testing using J-integral techniques shows a 40% loss of toughness compared to the 15 to 17% loss predicted from burst tests. A satisfactory laboratory test to predict the effect of hydrogen in full scale tests does not yet exist, but would be valuable.

(Author)

**A79-45598** **Distribution of gaseous hydrogen - Technology evaluation** W J Jasionowski, J B Pangborn, and D G Johnson (Institute of Gas Technology, Chicago, Ill.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 485-508 Contract No FY-76-C-02-2907

The present paper evaluates the feasibility of hydrogen delivery in natural gas distribution equipment. Attention is given to three operational model test loops: (1) a residential/commercial test loop with smaller sized components, (2) an industrial loop with larger sized components, and (3) a small safety test loop for special (created) leakage tests. Among the conclusions are, that the Joule-Thomson effect should not exceed 3 F for normal operations and that hydrogen leaks will not ignite spontaneously, hydrogen escaping from a leak expands adiabatically and then cools. M E P

**A79-45599** **Hydrogen storage technology for metal hydrides.** G Strickland (Brookhaven National Laboratory, Upton, N.Y.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 509-539 44 refs. Research supported by the U.S. Department of Energy.

Attention is given to the advantages of using hydrogen as a secondary energy carrier and factors pertinent to the technology of hydrogen storage via metal hydrides are briefly described. The technology is centered on iron-titanium hydride,  $\text{FeTiH}_x$ , as the most practical choice for the safe and compact storage of hydrogen. The features of such hydride reservoirs are described, and performance data are given for two reservoirs constructed at BNL. In addition the results of tests on the long term behavior of  $\text{FeTiH}_x$  are presented along with information on pressure drop in a hydride bed. Other topics covered include container materials selection, safety testing of  $\text{FeTiH}_x$ , hydride materials development, and the proposed Hydrogen-Halogen Energy Storage System. Finally, consideration is also given to current development needs. M E P

**A79-45600** **Liquid hydrogen fueled commercial aircraft.** G D Brewer (Lockheed California Co., Burbank, Calif.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 541-550

This statement reviews the probable future fuel problem facing the commercial air transport industry and suggests an innovative course of action. The plan involves creation of an experimental airline equipped with four liquid hydrogen fueled, wide-body aircraft flying commercial cargo on a regularly scheduled basis between the United States, Western Europe, and the Middle East. Development of facilities incorporating advanced technologies for production and liquefaction of hydrogen at each of four major air terminals is an integral part of the plan. (Author)

**A79-45601** **Assessment of hydrogen-fueled intercity trucking and rail transportation** R W Foster (Escher Technology Associates, St. Johns, Mich.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 551-567. 9 refs.

Hydrogen is generally acknowledged to be a 'long term' alternative fuel candidate which will begin to see significant use in the post 2000 time frame. The use of hydrogen as an alternative fuel in both the automotive industry and the rail industry is discussed. Attention is given to technological considerations such as engine conversion, fuel delivery system design, safety and reliability, as well as the effects on business operation practices and business economics. While it is concluded that there are significant problems to be overcome these problems do not preclude this fuel conversion. However, while the safety problems associated with fuel production, transmission and distribution appear acceptable based on past experience, no analysis of the risk management problems associated with the use of hydrogen in these transportation systems has been accomplished to date. M E P

**A79-45602** **Fuel uses of hydrogen in the residential/commercial/industrial sectors** N R Baker (Institute of Gas Technology, Chicago, Ill.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*.

Chicago, Institute of Gas Technology, 1979, p 569-582 10 refs.

In this paper, hydrogen as a fuel is discussed and its technical merits are examined. In anticipation of the time when natural gas can no longer satisfy the consumptive demand, hydrogen has been suggested as the obvious replacement. In order for hydrogen to play a major role as a residential, commercial, or industrial fuel, the effect of its substitution for natural gas in conventional combustion devices must be examined. This paper discusses several of hydrogen's combustion properties, principally in comparison with those of methane. The effect of converting existing burners to hydrogen use is discussed regarding energy input, operation, and emissions. Two differing hydrogen combustion techniques are reviewed, and their relative advantages discussed. In general, recent developments in hydrogen combustion devices have shown that such burners can be both cleaner and more efficient than their hydrocarbon counterparts. (Author)

**A79-45603** **Thermodynamic considerations in the production of synthetic fuels from coal.** R L Woolley (Billings Energy Corp., Provo, Utah) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 603-612

An attempt is made to determine, on the basis of thermodynamic considerations, which of the candidate fuel synthetics, methane or hydrogen, will have the lowest thermodynamic cost of coal conversion to synthetic fuels. It is proposed that a proper measure of the thermodynamic cost can be obtained in the classical manner as a comparative change in the energy availability of ideal processes. The considerations favor production of hydrogen over methane from coal. A sizeable loss in availability takes place when coal is gasified. The additional loss in availability to shift the stream to hydrogen is not large. It may be argued that the benefits that accrue from making this shift are well worth the thermodynamic price. In contrast, the thermodynamic penalty for making methane is sizeable, while the benefits are comparable to the benefits of hydrogen production. V.P.

**A79-45604** **How safe is hydrogen.** J Hord (National Bureau of Standards, National Engineering Laboratory, Boulder, Colo.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 613-643 79 refs.

The fire characteristics of hydrogen, methane and gasoline are different but do not significantly favor any one of these fuels. However, the risks due to fuel-air explosions in confined spaces are greatest for hydrogen. Industry has proven that all three fuels can be safely and easily contained in both gaseous and liquid phases. Hydrogen fires are more difficult to detect than methane or gasoline fires, but modern detection equipment makes it possible to quickly and reliably detect the flames of all three fuels. For equivalent energy storage or for equivalent volume storage, hydrogen has the least theoretical explosive potential of the three fuels considered. Regulations, standards and guidelines already exist for storage and transport of hydrogen. S D

**A79-45605** **DOE program on hydrogen energy systems.** J H Swisher (U.S. Department of Energy, Div. of Energy Storage Systems, Washington, D.C.) In *Hydrogen for energy distribution, Proceedings of the Symposium, Chicago, Ill., July 24-28, 1978*. Chicago, Institute of Gas Technology, 1979, p 645-671

Currently, thirteen program divisions within the Department of Energy are supporting research and development work on hydrogen energy systems. The scope of the activities is subdivided into

production, storage, transport, and conversion technologies, the principal effort being directed on the production of hydrogen using such energy sources as coal, electricity, nuclear process heat, and solar energy. The DOE hydrogen budget and hydrogen programs are discussed. V P

**A79-45745 Zn/x/Cd/1-x/S Cu<sub>2</sub>S heterojunction solar cells. II - Junction analysis** S R Das, A Banerjee, and K L Chopra (Indian Institute of Technology, Delhi, India) *Solid-State Electronics*, vol 22, June 1979, p 533-539. 19 refs. Research supported by the Ministry of Industrial Development.

**A79-45748 The extent of catalytic SO<sub>2</sub> reactions in smoke plumes (Das Ausmass von katalytischen SO<sub>2</sub>-Reaktionen in Rauchfahnen)** G Haury Staub - *Reinhaltung der Luft*, vol 39, July 1979, p 241-245. 20 refs. In German.

The chemical reactions of SO<sub>2</sub> in the atmosphere are studied, with regard to the assessment of injurious effects of SO<sub>2</sub> emissions from fossil fired combustion plants. Through laboratory experiments in a large environmental chamber and the use of a mathematical smoke plume model, it is determined what proportion of the overall reaction can be accounted for by catalytic reactions in the plume region. Finally, the results show that the catalytic reaction of the SO<sub>2</sub> with flyash particles in the plume is limited by the reaction speed, and that the limited reaction capacity of the particles is exhausted to a minor extent only in the plume itself. M E P

**A79-45749 Comparison of dust collection efficiencies of particulate emission samplers in a power plant burning fuel oil and coal fuel oil mixtures** P Van Acker and R Dams (Gent, Rijksuniversiteit, Ghent, Belgium) *Staub - Reinhaltung der Luft*, vol 39, July 1979, p 245-252. 12 refs.

**A79-45764 The conceptual basis of the electric utility sub-model of Project Independence Evaluation System** A L Soyster and R T Eynon (Virginia Polytechnic Institute and State University, Blacksburg, Va) *Applied Mathematical Modelling*, vol 3, Aug 1979, p 242-248. 21 refs.

A conceptual approach to integrating the supply and demand for electricity through an electric utilities submodel called Project Independence Evaluation System (PIES) is presented. The construction and approximation of nonlinear duration load curves within a linear framework is examined. The integration of supply with the demand oriented load curve into the process oriented supply function is discussed and attention is given to the difficulties associated with marginal cost pricing inherent in linear programming models. Lastly, a prototype example of the full-scale model is presented explaining the basic assumptions and methods that were employed. C F W

**A79-45776 Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volumes 1 & 2** Conference sponsored by the U S Department of Energy. Edited by G L Dugger. Laurel, Md, Johns Hopkins University, 1979. Vol 1, 543 p, vol 2, 196 p.

This volume focuses on the latest OTEC research and development work, test results, component design information, system integration efforts, and application investigations. Specifically, papers are presented on the U.S., French, and Japanese OTEC developments, waves and salinity gradients as energy sources, analysis of OTEC commercialization, heat exchanger development, power systems design, design and costs of platforms and cold water pipe, biofouling and microfouling problems, legal and institutional aspects, ammonia as working fluid, studies of oceanic environmental parameters, and alternate power systems studies. A T

**A79-45777 # Eurocean OTEC project** B A P L Lachmann (Association Europeenne Oceanique, Monaco) In *Ocean thermal*

energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 2A-1/1 to 2A-1/5.

The Eurocean ocean thermal energy conversion (OTEC) work and the proposal for a 10 MWe closed cycle pilot plant are reviewed. OTEC activities including cost estimates for 100 MW commercial size floating plants and combination with agriculture using the artificial upwelling or combination with biomass production for food, fertilizer, or fuel are discussed. The 10 MWe pilot plant will be built to test the OTEC system with full size modules, to verify the cost estimates for the commercial plant, and to examine possible use of less costly materials. Costs of OTEC electricity are compared with the costs of oil fueled power electricity. A feasibility study combining aquaculture/OTEC/desalination project is described. A T

**A79-45778 # French OTEC program** P Marchand (Centre National pour l'Exploitation des Oceans, Paris, France) In *Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1*. Laurel, Md, Johns Hopkins University, 1979, p 2A-2/1 to 2A-2/7. 8 refs.

The OTEC program which plans to build a pilot ocean thermal energy conversion (OTEC) plant in the 1 to 10 MWe range is reviewed. Past French experience in OTEC is discussed, and the feasibility study, testing of major components, and designing of the 1 to 10 MWe pilot plant are described. The shore based power plant concept is considered, noting the problem of laying cold water pipe. Open cycle OTEC schemes have several advantages over closed-cycle schemes using ammonia, and they produce desalinated water at nominal cost, although sea-water requires deaeration. The shore-based concept and the floating concept are being studied, and the use of offshore technology for the design of floating units is considered. It is concluded that the first small and middle-sized OTEC power plants will be located in equatorial islands. A T

**A79-45779 # An overview of the Japanese OTEC development.** T Homma (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan) and H Kamogawa (Toshiba Corp., Research and Development Center, Kawasaki, Japan) In *Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1*. Laurel, Md, Johns Hopkins University, 1979, p 2A-3/1 to 2A-3/5. 11 refs.

Design of 100 MW OTEC power plants, experimental studies of the power cycle, and application and assessment of OTEC systems in Japan are reviewed. A dynamic analysis was made of the platform and platform structure for the 100 MW commercial plant to optimize the plant configuration and its anchoring system. Optimum conceptual design of 100 MW plants on board of ship type and submerged disk type platforms was carried out and the major specifications and costs are given. Heat exchanger development with several types of tubes and tube plates is discussed, noting that titanium tubes are the best to resist corrosion, erosion, and biofouling. Studies of uranium exploration by OTEC and the possibility of marine biological productivity enhancement are described. The long time engineering test in the ocean environment will use a 1 MWe power system on board a barge with ammonia as a working fluid, and will be equipped with test facilities to evaluate the environmental effects. A T

**A79-45780 # Waves, salinity gradients and ocean currents - Alternative energy sources** M E McCormick (U S Naval Academy, Annapolis, Md) In *Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1*. Laurel, Md, Johns Hopkins University, 1979, p 2B-1/1 to 2B-1/6. 5 refs.

Ocean wave, salinity gradients, and ocean current energy conversion techniques are reviewed. Cavity resonator and wave focusing systems of ocean wave energy conversion are considered, emphasizing radiant wave interaction, Fresnel-type focusing, and conversion channeling. The salinity gradient system uses osmosis or

electrodialysis for converting the energy of high saline and low saline waters. Osmotic pressure conversion has the greatest energy potential, but its technology requirements are not yet ready. The reverse electrodialytic technology is available, and unlike osmosis, this method is not site dependent. A 75 MW ducted turbine supported around the periphery by liquid bearings is used to study the environmental effects, hydroelastic stability of the rotor blades and the mooring and anchoring systems in ocean current energy conversion. A T

**A79-45781 # Regional-scale sea surface temperature determination from the geostationary environmental operational satellite G A Maul** (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 2C-2/1 to 2C-2/6. 12 refs.

Sea surface temperatures determined from the digital GOES data base require five steps for quantification: first, the data have to be remapped into a rectangular matrix. Second, using optional decision strategy, cloud-free pixels are identified from joint visible-infrared probability distributions. Third, atmospheric corrections for infrared radiative transfer are calculated from upper air soundings in the region of interest. Fourth, the corrected satellite data are least-squares adjusted to surface observations because the GOES data have no absolute blackbody reference calibration. Fifth, the data are composited and prepared for analysis of variability with application to OTEC thermal resource. Error analysis of this scheme suggests that the rms error for 10 km resolution surface temperature will be  $\pm 1$  K or less. (Author)

**A79-45782 # Large cold tongues in the eastern Gulf of Mexico and their potential effect to OTEC F M Vukovich** (Research Triangle Institute, Research Triangle Park, N.C.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 2C-3/1 to 2C-3/4.

A large, narrow, cold tongue was detected in May 1978, extending southward from the northern boundary of the Loop Current. Similar tongues were detected in the spring of 1977 and 1975. The 1977 intrusion was described by Vukovich, et al (1978). These tongues penetrate as far as 400 km southward, and persisted for as long as 73 days. They originated as meanders on the northern boundary of the Loop Current. Limited in situ data (one case study) has indicated that there is greater cooling in the subsurface layers than in the surface layers in the cold tongues. This, in fact, produced an increase in the vertical temperature difference, or enhancement of the OTEC resource. Further study is needed to provide more substantial statistics. (Author)

**A79-45783 # OTEC ocean engineering progress report W. G. Sherwood** (U.S. Department of Energy, Washington, D.C.) and J. P. Walsh (Value Engineering Co., Alexandria, Va.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3A-1/1 to 3A-1/10. 8 refs.

The OTEC ocean engineering program to extract solar energy stored in the ocean surface water and to deliver it to the U.S. at a marketable price is reviewed. The thermodynamic system to extract the stored energy, the supporting equipment, and means of delivering it are considered as objectives of the OTEC program. The objective of the ocean engineering program is the design and construction of the resource delivery system. Platform subsystems, land-based plants, plant ship, and a spar platform for the 40 MWe plant are discussed. Design of the cold water pipe is considered, including bottom-mounted pipe, tensioned pipe, and pipe joints. It is concluded that a technical base of platform designs, cold water pipe designs, and moor

designs has been provided for designing, building, and operating a 40 MWe OTEC plant. A T

**A79-45784 # OTEC goes to sea /A review of Mini-OTEC/ L. C. Trimble and R. L. Potash** (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3A-2/1 to 3A-2/6. Research supported by the Lockheed Missiles and Space Co. and Dillingham Corp.

An overview of the Mini-OTEC project, including a description of the power plant, control system, instrumentation, cold water pipe (CWP) mooring system, and platform is presented. The Mini-OTEC is the first floating at-sea closed loop system using surface and deep seawater to generate 50 kW output, and it is installed on a moored barge incorporating CWP in the single anchor leg. Design data for heat exchangers, the turbine generator, fluid systems, control system, and instrumentation are presented. An engineering description of the moor, characteristics of the barge, specifications for the polyethylene CWP, and the crossover hose are provided. A static analysis was made to select a mooring leg configuration, component lengths, and anchor weight, and a dynamic analysis of the system response in a storm was performed to select line diameters, pipe and hose wall thickness, and buoy depth. A time-domain dynamic program was developed to simulate the seaway-induced motions and loads of the coupled mooring components. A T

**A79-45785 # Development of a Test Program for OTEC-1 P. Archibold** (Rockwell International Energy Technology Engineering Center, Canoga Park, Calif.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3A-4/1 to 3A-4/4.

The test program for the OTEC-1 ammonia power plant consisting of heat transfer experiments to validate the OTEC concept is reviewed. The program includes evaluation of shell and tube type heat exchangers, plate type heat exchangers, assessment of the impact of biofouling and corrosion, and monitoring of the performance of the cold water pipe. Selection of ammonia as the working fluid dictates that no copper bearing materials be used in the power system loop, and tests must be performed to evaluate biofouling and microfouling in absence of copper alloys. Shell and tube heat exchangers designed for 1 MWe duty with seawater flowing through titanium tubes are tested to demonstrate the system concept, and the resulting data will be compared with predicted data generated by the computer model. Pool boiling tests on an enhanced tube bundle and evaluation of the biofouling countermeasures involving Amertap and chlorination are considered. Instrumented tubes in each heat exchanger will be monitored during biofouling tests and provide data on the fouling resistance. A T

**A79-45786 # Analysis of prospects for OTEC commercialization for baseload power W. E. Jacobsen and R. N. Manley** (Mitre Corp., Metrek Div., McLean, Va.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3B-5/1 to 3B-5/7. 8 refs. Contract No. ET-78-C-01-2854.

Requirements for stimulating commercialization of OTEC systems for offshore generation of baseload electric power are analyzed. Commercialization potential was determined in a model which projects competitive economics of regional power-producing systems and estimates market entry and rates of commercial buildup. It was concluded that (1) OTEC could make a contribution to future baseload electric requirements in the southeast U.S. with 400 MWe plants, (2) OTEC performance could be improved by lower engineering costs and better system performance, (3) the establishment of 750 MWe precommercial capacity off Hawaii and Puerto Rico could

serve as U.S. mainland market springboard, and (4) no fundamental technical obstacles in achieving OTEC commercialization were identified, and major remaining problems are in the design, integration, construction, and deployment of marine components which are larger than the present offshore structures. A T

**A79-45787 # Performance tests of the 1MWt shell-and-tube heat exchangers for OTEC.** A Thomas, J. J. Lorenz, D. L. Hillis, D. T. Yung, and N. F. Sather (Argonne National Laboratory, Argonne, Ill.). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3C-1/1 to 3C-1/10 6 refs. Research sponsored by the U.S. Department of Energy.

Final test results are reported for the five 1 MWt shell-and-tube heat exchangers tested at Argonne National Laboratory. These five heat exchangers are the Union Carbide flooded-bundle evaporator, the Union Carbide sprayed-bundle evaporator, the Union Carbide enhanced-tube condenser, the Carnegie-Mellon vertical fluted-tube evaporator, and the Carnegie-Mellon vertical fluted-tube condenser. Performance parameters measured include the overall heat transfer coefficient (Mo), the water-side pressure drop, and the vapor quality. Also measured were operational characteristics of the heat exchangers such as repeatability of results and the dependence of Uo on heat duty, ammonia flow rate, and subcooling. Individual water-side and ammonia-side coefficients were deduced using the Wilson Plot method (Author)

**A79-45788 # Core unit testing of the APL/JHU shell-less folded tube heat exchanger.** J. L. Keirsey, J. A. Funk, P. P. Pandolfini, and R. T. Cusick (Johns Hopkins University, Laurel, Md.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3C-2/1 to 3C-2/6. 13 refs. Research sponsored by the U.S. Department of Energy.

A heat exchanger that meets the minimum overall objective for ocean thermal energy conversion (OTEC) plant-ships may not necessarily have the highest heat transfer performance but should have low fabrication cost, cleanability, modularity and maintainability. The shell-less, folded-tube heat exchanger being investigated by APL/JHU appears to offer advantages in these areas compared with some alternative designs. A full-scale core unit is being tested at the Argonne National Laboratory. The objectives of this core test are as follows: (1) to obtain experimental data on this novel design and (2) to validate or to provide a basis for modification of the APL computer code that will be used to estimate performance of a full-scale operational unit. The core test unit is described and is compared with a full-scale, 2.5-MWe, operational heat exchanger module. Results of evaporator core tests which began in April 1979 are compared with performance predictions and with results of separate internal and external heat transfer tests carried out in 1976-77. (Author)

**A79-45789 # Compact heat exchanger design progress.** J. H. Anderson, Jr. (Sea Solar Power, Inc., York, Pa.) and P. B. Pribis (General Electric Co., Schenectady, N.Y.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3C-5/1 to 3C-5/8

Development of compact plate type heat exchangers for OTEC plants is reviewed. The heat exchangers have horizontal, single pass water flow, vertical downflow condenser, and vertical upflow boiler passages. The design lends itself to many variations in type of water side configuration, and in boiling and condensing surface design. It makes high heat transfer coefficients possible, along with low pressure drops on the water and working fluid sides. Aluminum, cupro-nickel, titanium, steel, or combinations of different materials can be used in the clad form. The three test loops made it possible to

measure an overall heat transfer coefficient in a typical OTEC evaporator and condenser, the film side coefficient for boiling and condensing, and the water side heat transfer coefficient. It is concluded that overall heat transfer coefficients in the range of 1200 BTU/hr per sq ft per deg F and greater can be achieved using R-22 working fluid, and that the heat exchanger described is a practical and a low cost solution for OTEC. A T

**A79-45790 # Flow-induced vibration in shell-and-tube heat exchangers for ocean thermal energy conversion (OTEC).** J. J. Lorenz and D. Yung (Argonne National Laboratory, Argonne, Ill.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 3C-7/1 to 3C-7/6 18 refs

**A79-45791 # Preliminary designs of 10 MWe and 50 MWe power modules.** R. T. Miller, J. J. Gertz (Westinghouse Electric Corp., Steam Turbine-Generator Technical Operations Div., Pittsburgh, Pa.), and S. Cunningham (Gibbs and Hill, Inc., New York, N.Y.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 4A-1/1 to 4A-1/10. Research supported by the U.S. Department of Energy.

The results of preliminary design studies of a closed cycle 10 MWe modular experiment power system and the related commercial size 50 MWe power system module are presented. The system design including valve arrangement, evaporator tube bundles and hotwell storage as well as the liquid ammonia, which consists of a mix of condensate from the condenser and recirculated liquid from the evaporator storage, is examined. The heat exchangers and rotating equipment used are scaled logically from 10 MWe modular experiment size to 50 MWe modules suitable for commercial plants in the 400 MWe range. Conclusions show that power system modules for an OTEC power plant can be designed and constructed using proven technology and at a cost that appears competitive with alternative energy plants. C F W

**A79-45792 # TRW PSD-I power system design.** P. J. Bakstad and R. O. Pearson (TRW Defense and Space Systems Group, Redondo Beach, Calif.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 4A-2/1 to 4A-2/9 6 refs. Contract No. EG-77-C-03-1570

TRW has developed preliminary designs of 10 MWe power systems for OTEC. The PSD-I power system employs vertical, falling film, shell-and-tube heat exchangers with titanium tubes. The heat exchangers are externally mounted, immersed in seawater. The containment hull is a ship type platform. The PSD-II power system employs shell-less, plate-type heat exchangers made of aluminum. The power system is contained within the APL Plantship per contractor direction. The purpose of this paper is to present the PSD-I power systems design. A 10 MWe power module was developed offering high performance heat exchangers in a compact arrangement which lends itself to integration within surface coupled and surface decoupled (e.g., spar) type hulls. No major technical problems were unsolved. The heat exchangers, and within these, the tubes, represent the major power system cost element, therefore, alternate materials and production techniques should be pursued. (Author)

**A79-45793 # Performance optimization of an OTEC turbine.** S. P. Vincent (TRW Defense and Space Systems Group, Redondo Beach, Calif.) and C. H. Kostors (Elliott Co., Jeanette, Pa.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1. Laurel, Md., Johns Hopkins University, 1979, p. 4A-3/1 to 4A-3/6

The need for an ammonia turbine with maximized efficiency over the expected range of operation was determined during OTEC 10 MWe net power system optimization studies. It was determined that for every extra KW produced it was worth expending \$1,000 in plant cost. Specific application of state-of-the-art hardware designs were used to assure that the efficiencies determined were realizable. The turbine aerodynamic design considered axial flow and radial inflow turbines, single and double flow designs, and variations in the number of stages and base diameters. Consideration was given to the turbine-generator control scheme and specific areas of the turbine mechanical design such as the blades, seals and bearings. The optimum design is a four-stage axial flow double flow turbine directly connected to a four pole 60 hertz synchronous generator. The efficiency of the double-flow, four stage design is more than two percent higher than a one-stage, single flow design with diffuser. This is due to the latter's inherent very high exit velocity. Additional optimally designed stages can more efficiently recover this energy than a diffuser. Variable nozzles for the first stage are utilized for power maximization at off-nominal conditions. (Author)

**A79-45794 # Optimizing plant design for minimum cost per kilowatt with Refrigerant-22 working fluid.** M G Olmsted, M J Mann, and C S Yang (General Electric Co, Schenectady, N Y). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 4A-5/1 to 4A-5/6.

Basis for the selection of Refrigerant-22 and the basic logic and results of a power system design optimization and off design analysis program developed to support OTEC PSD 11 02 MWe heat exchanger and 10 MWe power module design and sensitivity analysis tasks are presented. The Freon properties program, 'heuristic direct search minimization' and 'Maxopt' Fortran programs incorporated into design optimization, and the optimization logic are described. The basic power system uses R 22 as the working fluid, plate type 'shell-less' cross flow heat exchangers, turbine driven seawater and condensate pumps and a single stage axial flow main turbine. A program to optimize the system capital costs using velocity, differential temperature, and saturation temperature was written for each heat exchanger, and block diagrams for the basic logic of this program and typical sensitivity analyses which resulted were presented. A T

**A79-45795 # Ocean Thermal Energy Conversion plant with Freon 22.** H Uehara, H Kusuda, M Monde, T Nakaoka (Saga University, Saga, Japan), and S Miyazaki. In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 4A-6/1 to 4A-6/8. 22 refs.

In this paper is treated the performance of an Ocean Thermal Energy Conversion plant using Freon 22 as the working fluid. The new plate-type heat exchanger is used as the evaporator and the condenser in this plant. The overall heat transfer coefficient of this plate-type evaporator is about 3000 kcal/sq m per h per C for Freon 22 for the case that the velocity of warm water is 1.2 m/s, and the inlet temperature of warm water is 28 C. The overall heat transfer coefficient of this plate type condenser is about 1500 kcal/sq m per h per C with Freon 22 for the case that the velocity of warm water is 1.0 m/s and the inlet temperature of cold water is 8.5 C. On the basis of these results, the design for a 25-MW OTEC plant module with Freon 22 is conducted and is compared with that of ammonia. (Author)

**A79-45796 # Conceptual designs and costs of OTEC 10/40 MW spar platforms.** R J Scott (Gibbs and Cox, Inc, Arlington, Va.). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 4B-1/1 to 4B-1/13.

This paper summarizes studies of conceptual designs of 10 and 40 MW Modular Application Platforms (MAP) of the spar configuration. The feasibility studies, which preceded these designs, evaluated trends in spar platform size and configuration as a function of alternative power system components and materials. These studies, summarized in this document, led to selection of a steel spar supporting external vertical heat exchangers as the lowest cost configuration. The conceptual designs of the 10 and 40 MW spar concepts selected during the early feasibility studies are described, including platform arrangements and modularity characteristics. The efforts required to integrate the dynamic response of the platform, cold water pipe and mooring system are described in detail. Concepts for construction and deployment are described, and estimates are presented for total system cost and schedule. (Author)

**A79-45797 # Design considerations on 100MWe commercial scale OTEC power plant and a 1MWe class engineering test plant.** T Homma, T Kajikawa (Ocean Thermal Energy Conversion Committee, Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan), H Kamogawa (Ocean Thermal Energy Conversion Committee, Tokyo Shibaura Electric Co, Ltd, Tokyo, Japan), S Nagasaki (Ocean Thermal Energy Conversion Committee, Tokai University, Tokyo, Japan), H Uehara (Ocean Thermal Energy Conversion Committee, Tokyo, Saga University, Saga, Japan), and T Teramoto (Ocean Thermal Energy Conversion Committee, Tokyo, University, Tokyo, Japan). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 4B-2/1 to 4B-2/7. Research supported by the Ministry of International Trade and Industry.

The design of 100 MWe OTEC power plant with respect to sites, economics, engineering and environment and the proposed 1MWe OTEC engineering test facility are examined. An analysis of the external force and dynamic properties is given for a surface ship type and a submerged cylindrical type platform installing the cold water pipe using the design criteria of Osumi and Toyama, Japan sites. Site selection and power system optimization for the 100 MWe plant are considered, and corrosion and biofouling of heat exchangers discussed, noting that titanium, copper-nickel, stainless steels, and hastelloy are being tested. The platform structure, the cold water pipe, and the environmental aspects are described. It is concluded that the OTEC power cost depends on oceanic and atmospheric conditions which determine the design temperature difference and capacity factor, with the cost at each site of 12.2-12.4 yen/kwh regardless of the length of the cold water pipe and capacity factor. The generating cost including cleaning was almost the same for the shell and tube and plate type heat exchangers. The anchoring system was estimated on the basis of the external force and dynamic properties for a surface ship and a submerged cylindrical type platform coupled with a cold water pipe. A T

**A79-45798 # A feasibility study of an OTEC guyed tower concept.** E H Pharr (J Ray McDermott and Co, Inc, New Orleans, La). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1. Laurel, Md, Johns Hopkins University, 1979, p 4B-4/1 to 4B-4/8. 7 refs.

A bottom supported guyed tower structure as a platform to support OTEC operations was studied. The study assumes environmentally hostile Atlantic or Gulf of Mexico sites to supply power to the U.S., and it rejects prior concepts of moving off station or abandoning the cold water pipe under 100 year storm conditions. The cold water pipe and transmission line problems are solved, and the structural adequacy, life, and station keeping ability are examined. Results of the study indicate that an OTEC/guyed tower power plant can be built and installed, with the optimum generating capacity yet to be determined. From a structural support standpoint, the optimum size is in excess of 1000 MW. A T

**A79-45817 # Preliminary results of a program to study OTEC oceanic environmental parameters at Punta Tuna, Puerto Rico.** G G Goldman and D Pesante (University of Puerto Rico, Mayaguez, P R) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 5C-6/1 to 5C-6/7 12 refs

**A79-45818 # Observations of water mass structure and variability north of St Croix, U S Virgin Islands for OTEC assessment** R S C Munier (Tracor Marine, Inc, Port Everglades, Fla), T N Lee, and S Chiu (Miami University, Miami, Fla) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 5C-7/1 to 5C-7/7 10 refs Contract No NOAA-3-7-022-35217

**A79-45819 # Ammonia vaporization and condensation investigations related to OTEC heat exchangers.** C M Sabin and H F Poppendiek (Geoscience, Ltd, Solana Beach, Calif) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 5D-3/1 to 5D-3/5 5 refs Contract No EY-76-C-03-1094

**A79-45820 # The modeling of thin film heat exchangers** S-C Yao, A W Westerberg (Carnegie-Mellon University, Pittsburgh, Pa), and N H Chao In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 (A79-45776 20-44) Laurel, Md, Johns Hopkins University, 1979, p 5D-4/1 to 5D-4/5 14 refs Contract No EY-76-S-02-2641-A004

The steady and dynamic behavior of thin film evaporators and condensers are simulated with a general thin film heat exchanger model. The dynamics of the gravity-controlled falling laminar film on horizontal or vertical tubes are studied in detail. For a first approach or for a slow transient a single-lumped model can be used. For a refined simulation or for a severe transient a grouped model is proposed. The grouped model preserves the unique feature of delay-time and wave-distortion of a transient, which was observed in a separate precise analysis. The thin film heat exchanger models are used in the dynamic simulation computer programs ODSP3 and OSCAR which were established at CMU for OTEC systems. Typical results are presented to demonstrate the capability of the model.

(Author)

**A79-45821 # Studies on OTEC power system characteristics and enhanced heat transfer performance in ETL.** T Kajikawa, T Agawa, H Takazawa, M Amano, K Nishiyama, and T Homma (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 5D-5/1 to 5D-5/8 6 refs. Research supported by the Ministry of International Trade and Industry

This paper describes experimental investigations on OTEC power system characteristics and the enhancement of the working fluid-side heat transfer surfaces at Electrotechnical Laboratory. The dynamic characteristics of the OTEC power system were investigated for the ETL-OTEC-II experimental facility. The responses to the change in the inlet conditions were detected. It was found that the time constants of the gas temperature at both the evaporator and the condenser were about 100 sec in spite of a small scale power system. According to an experiment on the noncondensable gas effect, the permissible noncondensable gas concentration ratio is suggested to be less than 0.05 wt % for the OTEC power plant. The fine metal fiber coated tubes at the evaporator and the double fluted tubes with drainage collars at the condenser were tested to demonstrate the

enhancement of heat transfer performance obtained by using Fron 114 as a working fluid. A single tube heat exchanger test facility for ammonia and Fron 22 is introduced.

(Author)

**A79-45822 # Ocean thermal and current velocity data requirements for design of an OTEC plant - An update.** R L Molinari (NOAA, Physical Oceanography Laboratory, Miami, Fla) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 6A-2/1 to 6A-2/9

**A79-45823 # Development of a lightweight concrete for OTEC cold water pipes.** A Litvin and A E Fiorato (Portland Cement Association, Skokie, Ill.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1

Laurel, Md, Johns Hopkins University, 1979, p. 6B-1/1 to 6B-1/8 14 refs. Research supported by the U S Department of Energy.

**A79-45824 # Oscillations of and drift force acting on an OTEC-CWP structure** S Nagasaki (Tokai University, Shimizu, Japan), M Nagatsuka, and H Kobayashi (Tokai University, Shimizu, Shimizu Construction Co, Ltd, Japan) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 6B-2/1 to 6B-2/6 8 refs

A model test dealing with the oscillations of and the drift force acting on the OTEC structure to investigate the effect of cold water pipe (CWP) and its attachment to the hull is outlined. Experimental details including model, wave basin, oscillation measurement, drift force measurement, and wave parameters are discussed. The CWP or rigid, semiflexible or flexible type is connected to a circular floating hull by rigid, universal joint or slide type attachment. Oscillation characteristics including heaving and pitching, surging, and drift force characteristics are described. It was found that the oscillations and drift force were larger with the universal joint and slide type attachment than with the rigid type, being the largest for the universal joint. The floating system with flexible CWP was subjected to oscillations and drift force smaller than those with rigid type. A T

**A79-45825 # Vortex excited oscillations of marine structures with application to the OTEC cold water pipe** O M Griffin (U S Navy, Naval Research Laboratory, Washington, D C) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 6B-4/1 to 6B-4/9 24 refs. Research supported by the U S Department of Energy

Vortex-excited oscillations of marine structures result in reduced fatigue life, amplified hydrodynamic forces, and sometimes lead to structural damage and to premature failure. The cold water pipe of an OTEC plant is nominally a bluff, flexible cylinder with a large aspect ratio ( $L/D$  = length/diameter), and is likely to be susceptible to resonant vortex-excited oscillations. The purpose of this paper is to survey recent results pertaining to the vortex-excited oscillations of structures in general and to consider the application of these results to the OTEC cold water pipe. These results are compared to design methods which have been developed for the dynamic analysis of marine structures and cable systems.

(Author)

**A79-45826 # Interleakage of ammonia and seawater in OTEC heat exchangers - Effects on corrosion and scale formation.** C F Schrieber, W D Grimes, and W F McIlhenny (Dow Chemical Co, Freeport, Tex) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 6C-1/1 to 6C-1/5



**A79-45827 # Oxygen, temperature and pH effects on corrosion of aluminum in seawater.** S C Dexter (Delaware, University, Lewes, Del.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1 Laurel, Md., Johns Hopkins University, 1979, p. 6C-2/1 to 6C-2/10. 31 refs Contract No. EY-76-S-02-2957.

The effects of dissolved oxygen, pH and temperature on the rate of initiation and growth of pitting and crevice corrosion of aluminum alloy 5052 and pure aluminum have been determined. Variations in pH and temperature rather than dissolved oxygen are shown to account for increased corrosion rates of 5000 series aluminum alloys that have been reported for deep ocean exposures. A combination of on site hydrographic measurements and electrochemical laboratory testing will make it possible to identify the most corrosive depths at any candidate OTEC site. The impact of these results on the use of aluminum for OTEC heat exchanger tubing and on possible approaches to corrosion control are discussed, particularly in relation to location of cold and warm water intakes and conditions that may develop during shutdown periods. (Author)

**A79-45828 # Qualification of a duplex, clad material for OTEC.** M J Mann, F B Bailey, and J F Mockler (General Electric Co., Schenectady, NY) In Ocean thermal energy for the 80's; Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1 Laurel, Md., Johns Hopkins University, 1979, p. 6C-4/1 to 6C-4/6. 13 refs.

Selection of copper-nickel/low carbon steel (Cu-Ni/LCS) clad material for OTEC heat exchangers is discussed. Four materials considered, titanium, stainless steel, aluminum alloys, and copper-nickel alloys are examined, noting that a compromise approach is to utilize a duplex, clad metal to provide seawater resistance, compatibility with the working fluid, and wall strength. This material is produced with a cold, 100% metallurgical bonding technique. The heat exchanger requires material with good seawater corrosion and erosion resistance, good heat transfer characteristics, and anti-fouling resistance on the seawater side. On the working fluid side, the material must operate with freon or ammonia and supply most of wall strength. It is concluded that a Cu-Ni/LCS clad material with 0.040 in. LCS and 0.010 in. Cu-Ni can meet these design criteria at low cost. The Cu-Ni provides corrosion resistance and anti-fouling characteristics, and LCS is compatible with freon and ammonia, provides strength, and is not susceptible to stress corrosion cracking. A T

**A79-45829 # The effects of biofouling and corrosion on heat transfer measurements.** B E Liebert, L. R. Berger, H J White, J. Moore, W. McCoy, J. A. Berger, and J. Larsen-Basse (Hawaii, University, Honolulu, Hawaii). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1

Laurel, Md., Johns Hopkins University, 1979, p. 7A-1/1 to 7A-1/10. 13 refs.

Four different metal heat exchanger tubes were deployed on a submerged buoy 40 ft below the surface 1000 ft from Keahole Pt., Hawaii. Nominal sea water velocity of 6 ft/sec was maintained on the internal surfaces of these tubes from Nov. 6, 1978 through March 9, 1979. Periodic samples from titanium, stainless steel, aluminum, and copper-nickel tubes were removed for biological and corrosion analyses. Weekly measurements of changes in heat transfer were made on each sample and attempts are made to correlate observed biofouling and corrosion data with changes in heat transfer. A discussion of predictive techniques for changes in heat transfer is also discussed. (Author)

**A79-45831 # OTEC 100-MWe alternate power systems study.** T J Rabas, J M Wittig (Westinghouse Electric Corp., Steam Turbine Generator Technical Operations Div., Lester, Pa.), and K Finsterwalder (Dyckerhoff and Widmann, Inc., New York, NY) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1

Laurel, Md., Johns Hopkins University, 1979, p. 7C-1/1 to 7C-1/13. 21 refs.

The results of cost studies for the open and hybrid OTEC cycles are summarized and cost comparison between these cycles and the previously analyzed closed cycle is presented. The major result of these studies is that the open cycle OTEC power systems are feasible and have a lower capital cost than the ammonia closed cycle system, and that the hybrid power system is not cost effective. The high steam turbine cost of the open cycle system was solved with fiberglass blades and a fabricated disk, and the removal of large quantities of dissolved gases in seawater was resolved by the use of high efficiency axial compressors and intermediate after-condensers. The open cycles have advantages of reduced biofouling and corrosion and the commercial potential of water production. Existing multi-stage flash evaporator saline water conversion technology is the basis for the open cycle flash chamber design, and the resulting power module designs are single vacuum housings containing all components. A T

**A79-45832 # Recent developments in the foam OTEC system.** C Zener, A Molini, T. Fort, Jr., J Fetkovich, and M. Greenstein (Carnegie-Mellon University, Pittsburgh, Pa.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1 Laurel, Md., Johns Hopkins University, 1979, p. 7C-2/1 to 7C-2/7

Analysis of the foam formation in the OTEC open cycle is presented. In this cycle warm water lifts itself several hundred feet, with a behavior which appeared to depend in a capricious manner on the temperature of the incoming water, the pressure of the spray condenser, and the foam mass flow rate. Foam making and foam breaking, the governing equations for the rise of a foam column, superheated incoming warm water, super pressurized incoming warm water, laminar vs turbulent flow, and surfactant concentration and slippage are discussed. An equation which governs the steady state rise of a foam column was derived by analysis and experiment, and it predicts the effects of controllable parameters, including the diameter and height of the column, on the foam behavior. It is shown that foam flows laminarily rather than turbulently, and has a well defined drag function. The drag function decreases as the inverse square of the column diameter. A T

**A79-45833 # Description and status report of a program to define sea water-surfactant interactions in relation to the foam system.** M I Kay (University of Puerto Rico, Mayaguez, P.R.). In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints Volume 1 Laurel, Md., Johns Hopkins University, 1979, p. 7C-3/1 to 7C-3/4. 8 refs. Research supported by the U.S. Department of Energy

The paper describes the scope of a project to investigate surfactant-sea water interactions with the objective of minimizing quantities of surface active materials. In addition, the second phase of the project is a determination of the surface tension variability of the upper layers of sea water. Topics discussed include: sea water variability experiments and sea water foam stability. Surface tension measurements are given which show some sample variability at the 10 meter level noting that this was encountered in two different types of measurements. Finally it has been determined that the solubility and diffusion requirements both seem to point to short groups but, C5 to C7 alcohols are, in high concentrations, anti-foaming agents. M.E.P.

**A79-45835 # Experiments on ultrasonic cleaning of a shell-less folded-aluminum-tube, OTEC heat exchanger.** P P Pandolfini, W. H. Avery, and F K Hill (Johns Hopkins University, Laurel, Md.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D.C., June 19-22, 1979, Preprints. Volume 1



Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8A-1/1 to 8A-1/5 6 refs Research supported by the U S Department of Commerce and U.S Department of Energy

**A79-45837 # Dynamic and off-design analysis of OTEC closed cycle power systems.** A W Westerberg, S Yao (Carnegie-Mellon University, Pittsburgh, Pa), S J Jennings, and W H Coleman (Westinghouse Electric Corp, Pittsburgh, Pa) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8B-1/1 to 8B-1/12 Contract No EG-77-C-03-1569

In the present study, power system analytical simulation programs were used to formulate and analyze an advanced OTEC Rankine cycle Least cost optimization algorithms, involving pattern search techniques, were used to show that anhydrous ammonia is the most suitable working fluid A unique power plant configuration was developed and shown to provide maximum power cycle efficiency Dynamic and off-design conditions were simulated on the OTEC power plant, and the requirements for heat exchanger hotwell capacities, liquid ammonia pump characteristics, connecting pipe sizes, valve specifications, storage capacities, and condenser venting loops were identified. V P

**A79-45838 # Steady-state and dynamic performance of an OTEC plant.** M Kayton (TRW Defense and Space Systems Group, Redondo Beach, Calif) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8B-2/1 to 8B-2/3

The paper deals with a mathematical model that was used for performance analysis of the PSD-1 and PSD-2 plants and for designing the control systems. The steady-state model includes simulations of such major system elements as heat exchangers (heat transfer and flow losses), moisture separator, turbine, pumps, pipes, fittings, and valves The model is organized into subroutines that can be individually modified A relaxation algorithm determines the steady-state flows and temperatures, given the dimensions and other variables The steady-state model achieves 1% accuracy in power, 0.3 psi accuracy in pressure, and 0.1 F accuracy in temperature V P

**A79-45839 # Design of land-based, foam OTEC plants for bottoming cycles.** A E Molini, C Zener, T Fort, Jr (Carnegie-Mellon University, Pittsburgh, Pa), M Santiago, A Herrera, J A Lopez, and R Martinez (University of Puerto Rico, Mayaguez, P R) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8C-1/1 to 8C-1/6 5 refs Contract No EG 77-78-S-02-4459-A000

Open cycle OTEC technology suggests new concepts for the embodiment of commercially feasible bottoming processes to recover energy from hot industrial effluents and simultaneously minimize their environmental impact The approach would make pollution abatement more economically attractive, yielding clean low-temperature flue gases while recovering a large portion of the thermal energy as electricity The technology opens the use of lower quality fuels without fear of air pollution caused by their flue gases A structural design for a unit 380 ft high, visualized as an inverted vertical reinforced concrete U tube 36 ft in diam and walls 11 in thick is examined V P

**A79-45840 # Multiple staging of the cold water in the open cycle OTEC Systems.** A E Molini, C Zener, and T Fort, Jr (Carnegie-Mellon University, Pittsburgh, Pa) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8C-2/1 to 8C-2/4 5 refs Contract No EG-77-78-S-02-4459-A000

Using the cooling water of the open cycle OTEC Systems in a multiple stage fashion results in its most effective utilization Such

use increases by 2-1/3 times the power production capability per unit mass of cold water, thus reducing the cost of the most expensive single item of an original installation Later stages could utilize the effluent from previously installed stages Also, the warmed effluent from the last stage could be utilized to enrich the nutrient value and CO2 absorption capacity of the ocean waters near to the surface A form of the 'six-tenth factor rule' was used to estimate the cost of multiple stage installations using as a basis the cost of the initial unit Results are presented relating the cost of the initial cold water supply system, number of stages, and power output per unit mass of original cold water at constant cost per unit of power (Author)

**A79-45841 # The mist-transport cycle - Progress in economic and experimental studies** A F Charwat (California, University, Los Angeles, Calif), R P Hammond, and S L Ridgway (R & D Associates, Marina del Rey, Calif) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8C-3/1 to 8C-3/9 5 refs Contract No W-7405

A preliminary design and cost analysis of an OTEC power plant utilizing the mist transport cycle has been conducted Arbitrary choices for the expected lift tube losses were made, other losses estimated from conservative engineering practice The plant cost is lift efficiency insensitive, and is of the order of \$1000/kW An experimental facility has been constructed by UCLA for the purpose of studying the essential fluid dynamics of the mist generation and mist transport process - a 3 ft diameter 24 ft tall vertical flow two-phase tunnel with supplies of vacuum, warm and cold water An orifice plate mist generator is at the bottom, and a vapor condenser is at the top The equipment shakedown phase is nearing completion, and data collection is beginning (Author)

**A79-45842 # Gravity opposed heat pipe** G P Wachtell (Franklin Research Center, Philadelphia, Pa) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8D-1/1 to 8D-1/4 9 refs

A gravity opposed heat pipe is proposed for rejecting heat to the deep ocean water, thereby eliminating the pumping power needed to pump cold water up to the ocean surface Heat pipe working fluid condensate is elevated to the vapor generator by entrainment in the vapor stream The vapor, generated as a result of heat rejected by the OTEC power cycle, flows down to the entrainment point, up to a separator, and finally down to the condenser, where it rejects its latent heat to the ocean water The gravity opposed heat pipe can be used in the power cycle itself, by placing a vapor turbine in the vapor stream (Author)

**A79-45843 # Thermoelectric OTEC** T S Jayadev, D K Benson, and M S Bohn (Solar Energy Research Institute, Golden, Colo) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8D-2/1 to 8D-2/8 13 refs Contract No EG-77-C-01-4042

A novel thermoelectric OTEC concept is proposed and compared with the ammonia closed-cycle designs The thermoelectric OTEC is a much simpler system which uses no working fluid and therefore requires no pressure vessel, working fluid pumps nor turbogenerator These components are replaced by power modules which are simply compact heat exchangers integrated with thermoelectric generators The thermoelectric OTEC offers several potential advantages including simpler and more easily mass produced components, higher reliability system performance through the use of a high level of redundancy and long-lived, solid-state thermoelectric generators, greater safety for crew and environment by elimination of the pressurized working fluid, and the possibility of lower system costs These comparisons are discussed and plans for future work are presented in the paper (Author)

**A79-45844 # Hybrid OTEC cycle avoids indirect heat exchangers** C E Jahng In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 1 Laurel, Md, Johns Hopkins University, 1979, p 8D-3/1 to 8D-3/4 5 refs

A hybrid OTEC cycle which uses air as a working fluid is presented. Indirect heat exchangers are avoided and the air is alternately warmed and cooled by direct contact with water to produce useful work from the expansion and contraction. Methods are described to decrease the buoyancy and size of equipment, such as by increasing the compression beyond that caused by the temperature change alone. In addition no water pumps are used since pressure changes produce the desired flow, making the system well suited to combinations with industrial manufacturing and aquaculture. Finally, based on a conceptual design the hybrid system can produce electric power of 2.9 cents/kWh compared to 3.9 cents/kWh by conventional technology burning coal. M E P

**A79-45845 # Use of satellite-derived sea surface temperatures by cruising OTEC plants** F K Hill and G L Dugger (Johns Hopkins University, Laurel, Md) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 2C-4/1 to 2C-4/6

The collection and use of satellite data on sea surface temperatures by cruising OTEC plants is reviewed. A 360,000 sq nautical mile tropical area near the equator with temperature differences of 22 to 23.9 C between surface and 900 m deep water is of particular interest to early OTEC plant deployment. To attain the highest temperature, a plant must cruise continually to seek out the warmest spot each month, and must know what course to follow in terms of increasing relative sea surface temperature. This temperature gradient can be obtained less expensively from satellite observations than from surface vessels or aircraft. Data supplied by the NOAA from the NODC files are compared to sea surface temperature data provided byITOS/NOAA polar orbiting satellites. Comparison of satellite measurements with surface measurements indicates that the view from space provides the areal coverage and the necessary resolution with respect to sea surface temperature gradients to navigate OTEC plantships to stay in the warmest water. A T

**A79-45846 # An overview of the OTEC-1 design.** N A Svensen (Global Marine Development, Inc., Newport Beach, Calif) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 3A-3/1 to 3A-3/15 Contract No ET-78-C-03-1785

An overview of the OTEC 1 system design including the vessel, the cold water pipe and deep water discharge, the power loop, the mooring system, and the anchoring site selection are presented. Systems integration is described in terms of interface design and installation requirements, manufacturing and assembly constraints, and materials considerations. The site survey is included to show the basis for the novel anchor design. The T-2 tanker Chepachet used for the OTEC-1 experiment has the ammonia power cycle located in a compartment provided by converting three ships centerline cargo tanks. A T

**A79-45847 # System design considerations for a floating OTEC modular experiment platform** J F George (Johns Hopkins University, Laurel, Md) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 3A-5/1 to 3A-5/5. 7 refs

A baseline design of an OTEC modular experiment platform has been completed. This design addresses the grazing option of OTEC power utilization, whereby a self-propelled platform cruises a

tropical ocean area and uses the OTEC power to synthesize an energy-intensive product (e.g., ammonia). The paper describes the system integration requirements and the resulting design of the hull structure, OTEC power system and cold water pipe. The cost for acquiring and deploying this platform outfitted with a 10 MWe (net) OTEC power system is presented. These data are available to DOE to serve as baseline information to industry in subsequent design and construction phases of the OTEC program. (Author)

**A79-45848 # Electric utility system planning studies for OTEC power integration** F Pérez Bracetti (Puerto Rico Water Resources Authority, San Juan, P R) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 3B-2/1 to 3B-2/7 8 refs

The plan of generation expansion study assuming availability of commercial OTEC plants together with the coal, oil, and nuclear utilities is discussed. Generation system, electrical system, licensing, and environmental problems are considered, with generation expansion based on a system planning method using reliability criteria complemented with analyses of reserve requirements. Alternative generation expansion schemes, reliability evaluation, energy production costs, and OTEC break-even requirements are included in the plan, with determination of costs for various voltages, capacities, and maximum reliability cable configurations considered in the electrical portion of the plan. The licensing of a stationary sea floating facility and the role of regulatory agencies is discussed. The design of the environmental study is focused on the OTEC platform attraction for the pelagic organisms, and the nature and extent of this effect is an important factor in OTEC platform siting bearing potential effect on project feasibility. A T

**A79-45849 Status of solid polymer electrolyte electrochemical cell technology for electrolytic hydrogen generation and fuel cell power generation** L J Nuttall (General Electric Co., Wilmington, Mass) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 3B-3/1 to 3B-3/6

The possible use of hydrogen as an energy vector is being considered for some of the possible OTEC scenarios. This requires an efficient means of producing the hydrogen from electrical power on board the OTEC platform, and also for converting it back to electrical energy at the other end of the distribution network. Under a program sponsored in part by DOE and some of the electric and gas utilities, General Electric is developing a new solid polymer electrolyte water electrolysis technology which offers a potential efficiency of 85-90% and capital costs in the range of \$100/kW. This paper presents a brief description of the technology and discusses the current status of the program relative to a planned 5 MW demonstration plant which is expected to be completed in 1983. The solid polymer electrolyte technology has also been studied for use in a hydrogen/halogen regenerative fuel cell system for energy storage. A concept is presented for adapting this approach to a primary H<sub>2</sub>/O<sub>2</sub> fuel cell by combining it with a catalytic process for converting HCl into H<sub>2</sub> and H<sub>2</sub>O. For such a system, fuel cell efficiencies in the range of 70-80% may be feasible. (Author)

**A79-45850 # OTEC system response and control analysis** W L Owens (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md, Johns Hopkins University, 1979, p 4A-4/1 to 4A-4/7

An analysis is presented for OTEC system response and control. Two basic operational modes are considered consisting of constant and variable flow seawater pumps. Variable flow seawater pumps allow optimization of the OTEC thermal cycle state points for maximization of net generated power. Constant flow pumps are cheaper and simpler, but do not permit direct control over the

evaporator and condenser operating temperatures. A system of nonlinear differential equations representing the basic elements of a constant seawater flow OTEC plant has been formulated for computer solution. Typical response curves are presented for pressures, temperatures, mass flow rates, and generator speed for the Mini-OTEC plant scheduled for operation later this year. (Author)

**A79-45851 # Station keeping subsystem designs for modular experiment OTEC plants.** N S Basar, J C Daidola, and R C Sheffield (M Rosenblatt and Son, Inc., New York, N Y.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 4B-3/1 to 4B-3/4.

Conceptual design of the station keeping subsystem (SKSS) for 40 MWe modular experiment OTEC platforms is discussed. Design approach consists of developing the matrix of SKSS concepts, investigation of site locations, the mooring system stress analyses, and a framework reliability, performance, and optimization analysis scheme. The SKSS matrix consists of tension leg and catenary systems, the stress analysis includes computation of wind, current, and wave forces and the first order seakeeping motions of the vessel, and performance, reliability, cost, deployment, and maintenance are considered in the optimization study. It is concluded that a multileg spread catenary using wire rope and chain for mooring lines, and a vertical tension leg type mooring are the best SKSS concepts for the SPAR platform, and the same catenary with a single buoy mooring concept are the best for the BARGE platform. A T

**A79-45854 # Legal aspects of siting OTEC plants offshore the United States, on the high seas, and offshore other countries.** J D Nyhart (MIT, Cambridge, Mass.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 4D-1/1 to 4D-1/9 111 refs.

The legal issues of siting OTEC plants offshore in US and foreign countries and on the high seas are presented. The legal questions for each specific site are presented in terms of international legal and political framework, international arrangements, regulatory law, criminal law, private and residual law, and financing. In comparing the OTEC sites in the three areas, it is found that the sea law will result in coastal state dominance of sites within 200 miles offshore, and the international arrangements will seek benefits for the US and foreign countries, and more attractive investment by private sources, and will be defensive in nature in protecting US interests. Recommendations regarding OTEC and the law of the sea conference include legislation regulating the deployment and operation of OTEC devices within 200 miles off its coast, and changes in criminal and private law for OTEC development and commercialization. A T

**A79-45855 # Potential for ocean thermal energy conversion electric power generation in the Southeast region.** P L Sutherland (Florida Power and Light Co., Miami, Fla.), F G Arey, Jr., and D H Guild (Stone and Webster Engineering Corp., Boston, Mass.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 5A-1/1 to 5A-1/6 5 refs.

Evaluation of the operating characteristics and investment costs of an OTEC electric power plant in the Southeast US is presented. Conceptual design of an OTEC plant is discussed with the capital cost estimate, and conventional coal fuel plant costs. A computer analysis is made of the life cycle costs of electric power generation with conventional generating plants, and an OTEC plant substituted for a coal plant of a capacity that provides equal system reliability. A present worth of revenue requirements cost analysis is then made of the revised system expansion plan that includes the OTEC plant. The

comparative difference between the present worth life cycle costs of the two expansion plans determine the break-even capital investment that can be made in an OTEC plant. It is concluded that OTEC holds the greatest promise in comparison to other renewable energy sources available in the Southeast for central station power generation. A T

**A79-45856 # Results of a near field physical model study.** E E Adams, D J Fry, and D H Cox (MIT, Cambridge, Mass.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 5C-1/1 to 5C-1/7 Contract No. ET-78-S-02-4683.

Experimental investigation of external fluid mechanics associated with OTEC plants is presented. Tests were conducted under stagnant and flowing conditions, using the mixed discharge (combined evaporator and condenser) and nonmixed discharge concepts. Measurements included temperature, dye concentration, mean velocity, and visual observations from still and motion pictures. Stagnant water tests showed no significant recirculation except where the discharge ports were oriented upward or where the largest plant (600 MWe) was tested. There was no significant difference in recirculation between the mixed and nonmixed discharge designs although differences in the equilibrium positions of the discharge plumes were noted. The flowing condition tests are still in progress. A T

**A79-45857 # Environmental impact assessment for OTEC-1.** L Sinay-Friedman (TRW Defense and Space Systems Group, Redondo Beach, Calif.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 5C-2/1 to 5C-2/6 9 refs.

Environmental impact assessment of 1 MWe set of heat exchangers aboard the OTEC-1 early ocean test platform is presented. The key environmental issues assessed were organism entrainment and impingement, ocean water mixing, platform attraction, chlorine releases, ammonia leakage, oil spills, atmospheric pollution, endangered species, and socioeconomic. The overall findings are that nearfield biological effects of OTEC-1 will be localized within a few hundred meters of the vessel, and their impact will be negligible in view of the broad distribution of pelagic organisms. Farfield effects on nearshore populations, whose habitats may be more restricted, will be insignificant. A T

**A79-45858 # Modeling the intermediate field of ocean thermal energy conversion discharges.** G H Jirka, J M Jones, and F E Sargent (Cornell University, Ithaca, N Y.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2. Laurel, Md, Johns Hopkins University, 1979, p 5C-3/1 to 5C-3/7 10 refs. Contract No. ET-78-S-02-4683.

The intermediate field of an OTEC plant is defined as that region in the surrounding stratified ocean where the plant effluents are distributed through the interaction of buoyancy driven currents and the ambient ocean current. The intermediate field determines the area over which physical, chemical and biological disturbances from the plant can be felt and measured. The governing equations of the intermediate field motion are derived and first order solutions are given. The results, including some experimental verification, document the significant horizontal (order 10 km) and vertical extent (order 10 m) of the intermediate field layer. Siting consequences for multiple OTEC plants and additional hydrodynamic drag effects are discussed. (Author)

**A79-45859 # Experimental and analytical OTEC studies at ORNL.** J W Michel (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22,

1979, Preprints Volume 2 Laurel, Md., Johns Hopkins University, 1979, p 5D-1/1 to 5D 1/8 10 refs Contract No W-7405-eng-26

The results of ammonia heat transfer experiments and various analytical studies of OTEC heat exchangers are summarized. Work done since that reported at the Fifth OTEC Conference includes additional ammonia condensation tests on several vertical fluted tubes and on tubes inclined at 30 deg from vertical position. The main conclusions from these tests are that the high condensation coefficients previously reported for fluted tubes have been verified and they seem to be insensitive to tube length over the range tested. Also, tilting the tubes significantly improves the performance of smooth tubes and causes a slight decrease in the performance of fluted tubes. Testing of vertical tubes for ammonia evaporation is currently in progress with evaluation of both in tube and outside tube evaporation experiments planned. Analytical studies include evaluating the cost effectiveness of various types of heat transfer enhancement and performing a survey of heat exchanger joinability. Also, several studies are in progress relative to alternate OTEC cycles and components for these cycles (Author)

**A79-45863 # Dynamic analysis of pipeline system for thermal power generation facility.** T Yokoyama, Y Arai, and T Katoh (Showa Denko, Tokyo, Japan) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19 22, 1979, Preprints Volume 2

Laurel, Md., Johns Hopkins University, 1979, p 6B 3/1 to 6B 3/4 Research sponsored by the Tokyo Electric Power Co

A stability study of a fiber reinforced plastic (FRP) pipe is presented. The criteria for stability of the structural design are given. Mathematical models are constructed for cantilever and simple beams, and the approximated transfer functions are obtained through Laplace transform and Galerkin's 5th order polynomial fitting. Finally, design criteria are obtained in the form of stiffness, fluid velocity, material properties, and scale dimensions M E P

**A79-45864 # Use of the new stainless alloys for OTEC heat exchangers.** J R Maurer (Allegheny Ludlum Steel Corp., Brackenridge, Pa.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19-22, 1979, Preprints Volume 2 Laurel, Md., Johns Hopkins University, 1979, p 6C-3/1 to 6C-3/8 9 refs

New stainless steel alloys resistant to seawater and other highly aggressive environments are presented. These alloys, which include AL-6X (20 Cr-24Ni-6Mo), were made possible by recent developments in steel melting and processing technology, and are considered viable alternatives for OTEC heat exchangers. Examples of test and operating experience in power plant condensers are given, including corrosion resistance, fouling, heat transfer, and other areas pertinent to OTEC applications. The new ferritic stainless steels are reviewed as candidates for thin wall heat exchangers, and details of condenser operating experiences in brackish and fresh water environments are included. Installation and fabrication of rolled and welded tube/tube sheet joints are covered, including rolling procedures and joint strengths for various material combinations A T

**A79-45870 # Application of the Cathelco system for control of fouling in OTEC systems.** C W Smith (CV Associates, McLean, Va.), B J Kirk (Cathelco, Ltd., Chesterfield, Derby, England), and W J Blume (Blume Worldwide Services, Scarsdale, N Y.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C., June 19-22, 1979, Preprints Volume 2 Laurel, Md., Johns Hopkins University, 1979, p 8A 2/1 to 8A-2/3

The development of the Cathelco system for control of fouling and its possible application to OTEC systems is outlined. The system employs two different anodes at a very low current (1) marine growth anodes which release copper ions preventing the settlement

of the primary forms of biofouling on surfaces within the system being protected, and (2) trap corrosion anodes which release aluminum serving as a conditioner to enhance deposition of the copper anti-foulant throughout the system, forming a protective coating and reducing corrosion. Systems have been designed for flows of 3000 to 17,000 gpm which operated successfully. OTEC problems of macrofouling, systems with long pipe runs, flow treatment, microfouling, and the ecological implications of using the Cathelco system are discussed A T

**A79-45871 # Land-based application of an OTEC open-cycle power system.** F C Chen (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Ocean thermal energy for the 80's, Ocean Thermal Energy Conversion Conference, 6th, Washington, D C, June 19 22, 1979, Preprints Volume 2 Laurel, Md., Johns Hopkins University, 1979, p 8C-4/1 to 8C-4/6 9 refs Contract No W-7405-eng 26

OTEC power system technology, although primarily developed for the utilization of renewable ocean thermal sources, could conceivably also be applied to other types of low-temperature heat sources. For utilizing rejected heat from large thermal power plants, application of open-cycle steam turbine technology to additional very low pressure turbine stages as an integral part of the thermal power plant appears to be more cost effective than a separate bottoming cycle system, where OTEC range cold water is economically available. For utilizing rejected heat for power generation from nuclear facilities, the open cycle has the advantage of not requiring isolation heat exchangers to avoid cross contamination of GDP cooling water. A conceptual thermal analysis of such open-cycle power systems is presented in the present paper V P

**A79-45923 Electromagnetic interference to television reception caused by horizontal axis windmills.** D L Sengupta and T B A Senior (Michigan, University, Ann Arbor, Mich.) *IEEE, Proceedings*, vol 67, Aug 1979, p 1133-1142 14 refs Contract No. EY-76-S-02-2846

Electromagnetic interference to television (TV) reception produced by horizontal axis wind turbine generators or windmills has been identified and quantified by comprehensive theoretical and experimental studies. It is found that the rotating blades of a windmill can produce pulse amplitude modulation (PAM) of the total signal received, and that for an antenna so located as to pick up the specular or forward scattering off the blades, this extraneous modulation can distort the video portion of a TV signal reproduction in the vicinity of the windmill. The distortion is worst at the higher frequencies, and therefore, poses more of a problem at UHF than VHF. Based on laboratory studies as well as on site measurements, a modulation level has been established at which the video interference is judged 'acceptable,' and this threshold of interference is substantially independent of the ambient signal strength. A theory has been developed to compute the interference region about a windmill for any given TV transmitter, and the results are in good agreement with those obtained from on site measurements with an operational windmill (Author)

**A79-45974 Performance parameters for fusion-fission power systems.** D J Bender (California, University, Livermore, Calif.) *Nuclear Technology*, vol 44, Aug 1979, p 381-389 12 refs Contract No W 7405-eng-48

A fusion-fission power system is considered in which fissile-producing hybrid (or fusion-fission) reactors supply the makeup fuel needs for fissile-consuming, or converter, reactors. As a result of the diverse nature of the hybrid reactor, a number of general performance parameters are proposed that will permit comparison of various hybrid reactor configurations. In addition, the relationships developed are used to show that scientific feasibility or 'breakeven' for the hybrid reactor is near at hand in the fusion program and that attractive commercial reactors can be based on near-term plasma physics (Author)

**A79-45979 Thermal energy conversion - Tapping the sea depths** J H Rumbaugh, T F Garrity, R Cohen (U.S. Department of Energy, Washington, D C), and R L Sullivan (Florida, University, Gainesville, Fla.) *IEEE Spectrum*, vol 16, Aug 1979, p 42-48 17 refs

Thermal energy conversion through electricity-to-shore schemes and manufacture at ocean installations of energy-intensive products such as ammonia, hydrogen and aluminum is discussed. Three phases of development are presented. The first phase uses a small scale OTEC heat exchanger with 1 MW thermal capacity, in the second, a T-2 tanker is refitted for providing data on biofouling, cold-water plume, fluid dynamics, cleaning and general environmental impact. The third phase, to be started in 1984, is a pilot plant of 10 MW electricity that will provide energy for the U.S. islands through ocean platforms. Special attention is given to open- and closed-cycle power plants, discussing their technical feasibility and subsequent costs as well as the design and deployment of submarine power cables enabling the conversion of thermal energy to electrical power. C F W

**A79-45991 The effect of coal characteristics on the catalytic liquefaction of Utah coals.** G T Garr, J M Lytle, and R E Wood (Utah, University, Salt Lake City, Utah) *Fuel Processing Technology*, vol 2, July 1979, p 179-188 15 refs. Research supported by the Mineral Leasing Fund

**A79-45992 Selectivity improvement in the SRC process** D Garg, A R Tarrer, J A Guin, J M Lee, and C W Curtis (Auburn University, Auburn, Ala.) *Fuel Processing Technology*, vol 2, July 1979, p 189-208 6 refs. Research supported by the U.S. Department of Energy

The selectivity for hydrodesulfurization over hydrogenation was examined in a new short residence time catalytic two-stage solvent refined coal process, (SRC), with the potential of producing a low-sulfur solid SRC product to meet the proposed EPA new point source emission standards. Residence time and hydrogen consumption are minimized in the first stage by mineral catalyst (SRC residue ash) treated under a combustion environment to improve its selectivity for hydrosulfurization over hydrogenation. The second stage involves hydrotreating the filtered liquid product with a Co-Mo-Al catalyst, before splitting into a solid SRC and solvent recycle by distillation. The type of coal, catalyst, temperature, hydrogen partial pressure, and reaction time were examined to provide information on hydrogen consumption, product distribution, sulfur removal, SRC yield, and solvent quality. The results show that selectivity in two stage hydrodesulfurization of coal is improved by high reaction temperatures, short residence times, the SRC residue ash as a first stage catalyst, and Co-Mo-Al as a second stage catalyst, and that two stage catalytic SRC processing is more selective for hydrodesulfurization than catalytic or non-catalytic single stage SRC processing. A T

**A79-45993 Changes within tin-containing catalysts under hydrorefining conditions** J F Kriz, K Belinko, B N Nandi, and D S Montgomery (Department of Energy, Mines and Resources, Energy Research Laboratories, Ottawa, Canada) *Fuel Processing Technology*, vol 2, July 1979, p 221-226 5 refs

Changes in tin-containing catalysts for bitumen upgrading under hydrorefining conditions are reported. Tests were performed in a bench-scale fixed-bed reactor, and compared with pure alumina, tin compounds supported on alumina showed only marginal improvements in liquid product quality in bitumen hydrorefining. Behavior of four catalysts is described, including alpha alumina monohydrate gelled with acidified water, and made into an extrudate impregnated with SnCl<sub>2</sub>. Microscopic examinations of the used extrudates revealed extensive sintering of the tin component into the cracks of alumina. The formation of SnS from SnCl<sub>2</sub> and its sintering is discussed, and it is concluded that the original dispersion of tin compounds on the catalyst supports significantly decreased within a short period of time. Changes in the dispersion were observed when different methods of preparation were applied. An improved catalytic system would require a stronger bond between the tin compound and the support to hinder surface migration. A T

**A79-45994 A survey of methods of coal hydrogenation for the production of liquids** J M Lytle, B C B Hsieh, L L Anderson, and R E Wood (Utah, University, Salt Lake City, Utah) *Fuel Processing Technology*, vol 2, July 1979, p 235-251 114 refs

**A79-45995 Photochemical energy conversion studies in systems containing methylene blue.** A S N Murthy and K S Reddy (Indian Institute of Technology, New Delhi, India) *International Journal of Energy Research*, vol 3, July-Sept 1979, p 205-210 20 refs

The behavior of photogalvanic cells containing methylene blue with various reducing agents has been examined. Appreciable potentials and currents have been detected. The power conversion efficiency of an EDTA-methylene blue (EDTA - ethylene diamine tetra-acetic acid) photogalvanic cell has been estimated to be about 0.04%. The storage of light energy in iron-methylene blue and EDTA-methylene blue systems has been studied. (Author)

**A79-45996 Vehicle evaluation of neat methanol - Compromises among exhaust emissions, fuel economy and driveability.** N D. Brinkman (GM Research Laboratories, Warren, Mich.) *International Journal of Energy Research*, vol 3, July-Sept 1979, p 243-274 28 refs

Methanol as an alternative fuel in vehicles with spark-ignited, internal combustion engines is evaluated. A methanol-fueled model car, equipped with electronic fuel injection was modified to provide proper air-fuel ratios for methanol. Exhaust emissions and fuel economy, using an average equivalence air-fuel ratio of 0.96 and spark-timing, designed for the production gasoline car, were compared. It was found that methanol fuelling with a 0.96 ratio using best-power rather than production spark timing increased fuel economy from 3 to 6% without significantly affecting emissions and driveability. Furthermore, with best-power spark-timing and a maximum economy air-fuel ratio of 0.83, driveability was acceptable and the CO and NO emissions met the 1977 standard. Although feasibility and benefits of operating vehicles with neat methanol were demonstrated, not all problems of methanol fuelling (i.e., cold starts) were solved and other alternatives such as obtaining hydrocarbon liquids from coal should be considered. C F W

**A79-46050 Solar power for telecommunications.** M R Mack (Telecom Australia, Australia) *Telecommunication Journal of Australia*, vol 29, no 1, 1979, p 20-44

This article outlines the basic theory of solar photovoltaic power systems and the way in which Telecom Australia is applying these systems to provide relatively small quantities of power for communication systems in areas where mains power is not available. It includes methods used to dimension the solar array and battery and describes how the power generated by the solar array is controlled. Future trends and use of solar cells are also briefly discussed. (Author)

**A79-46065 Numerical modeling of the thermal boundary layer near a synthetic crude oil plant.** A Kumar (Syncrude Canada, Ltd., Edmonton, Alberta, Canada) *Air Pollution Control Association, Journal*, vol 29, Aug 1979, p 827-832 15 refs

The paper presents a numerical model for the prediction of thermal boundary layer (TBL) height as a function of time of day based on the solution of appropriate conservation equations relating both the heat flux and the temperature jump across the inversion layer to the height of the TBL. The resulting equations are solved by the Runge-Kutta method. It is shown how the model is tested against the field data collected as part of a base-line data acquisition program. In addition, a comparison is also made of two different methods (kink method and conventional method) to calculate thermal boundary heights from the mini-sonde data. Problems in the use of the results of TBL heights using these two methods for predicting pollution potential near a tar sands plant are also discussed. M E P

**A79-46152** Efficient electron-beam-deposited ITO/n-Si solar cells. T. Feng, A. K. Ghosh, and C. Fishman (Exxon Research and Engineering Co., Linden, N.J.) *Journal of Applied Physics*, vol. 50, July 1979, p. 4972-4974. 15 refs. Contract No. E(04-3)-1283.

Indium tin oxide/silicon heterojunction solar cells with power conversion efficiencies of 10% in the AM1 solar spectrum were fabricated. The indium tin oxide (ITO) films were deposited onto n-type silicon by electron-beam evaporation of a mixture of 90/10 molar% In<sub>2</sub>O<sub>3</sub>/SnO<sub>2</sub> powder. As in SnO<sub>2</sub>/n-Si cells, the efficiencies of these cells depend upon the angle of incidence of the ITO vapor stream to silicon. The photovoltaic properties of these cells have been found to be very similar to those of SnO<sub>2</sub>/n-Si devices. (Author)

**A79-46157** Variation of photovoltaic effect in vertical n/p-junction solar cells. Y. T. Yang (National Tsinghua University, Hsinchu, Nationalist China) *Journal of Applied Physics*, vol. 50, July 1979, p. 5047-5049. Research supported by the National Science Council and TDK Co.

It is shown experimentally that the power output of an ordinary vertical silicon single crystal solar cell varies with the local illumination. In the case where the illuminated areas are only a small portion of the surface area, the dark current was independent of the location of illumination. For a fully illuminated vertical solar cell, the dark current may increase or decrease, depending on whether the impurity concentration is inhomogeneous or homogeneous, whereas the short-circuit current increases in either case. V.P.

**A79-46201** Spray-deposited high-efficiency SnO<sub>2</sub>/n-Si solar cells. T. Feng, A. K. Ghosh, and C. Fishman (Exxon Research and Engineering Co., Linden, N.J.) *Applied Physics Letters*, vol. 35, Aug. 1, 1979, p. 266-268. 8 refs. Contract No. E(04-3)-1283.

SnO<sub>2</sub>/n-Si solar cells (area = 1 and 4 sq cm) having AM1 efficiencies of 12.3% on single-crystal silicon and 10.1% on polycrystalline silicon have been fabricated. The tin oxide is deposited by spraying a SnCl<sub>4</sub> mixture onto heated silicon substrates. Using this low-cost process, large area (20-sq cm) single-crystal cells having 10% efficiency have also been made. The smaller diffusion length and higher resistivity in the polycrystalline silicon accounts for its lower efficiency as compared to single-crystal cells. (Author)

**A79-46202** Spectrally selective surfaces of Ni-pigmented anodic Al<sub>2</sub>O<sub>3</sub>. C. G. Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden), A. Andersson (Granges Aluminium, Finspang, Sweden), and O. Hunderi (Norges Tekniske Hogskole, Trondheim, Norway) *Applied Physics Letters*, vol. 35, Aug. 1, 1979, p. 268-270. 28 refs.

The spectral selectivity and technical properties of Ni-pigmented anodic Al<sub>2</sub>O<sub>3</sub>, a possible coating in photothermal solar energy conversion, are examined. Coatings are obtained by dc anodization in dilute phosphoric acid, followed by blackening by ac electrolysis in a bath containing NiSO<sub>4</sub>. Accelerated tests at 300 C and severe humidity conditions produce no significant degradation of properties, indicating high durability. Scanning electron microscopy, Auger depth profiling and atomic absorption analysis lead to the formulation of a structural model of the coating, in which a thin layer comprising a mixture of Ni and Al<sub>2</sub>O<sub>3</sub> is located near the bottom of the anodic film. Spectral reflectance experiments indicate a high degree of spectral selectivity, which is explained in terms of the model structure by the Bruggeman (1935) theory. A. L. W.

**A79-46221** Interannual and month-to-month variations of wind speed. C. G. Justus, K. Mani, and A. S. Mikhail (Georgia Institute of Technology, Atlanta, Ga.) *Journal of Applied Meteorology*, vol. 18, July 1979, p. 913-920. 9 refs.

Spatial cross correlations and interannual and month-to-month variations of monthly mean wind speed are studied at 40 sites that span 21 states, including Alaska and Hawaii, plus one Pacific Ocean site (Wake Island). The sites are selected on the basis of availability of 10 or more years of data from a fixed location with constant

anemometer level and having a climatic mean wind speed of 5 m/s or higher. Also discussed are time correlations and persistence probabilities. Probability distributions of monthly and annual mean speeds are found to be nearly Gaussian with respect to climatological monthly or annual mean. Conclusions are drawn on spatial cross correlations and wind speed variability. A persistence probability of about 63% is established. S. D.

**A79-46228** Mathematical modeling of electrical energy consumption and heating requirements by municipal wastewater treatment plants. M. H. Wang (New York State, Dept. of Environmental Conservation, Albany, N.Y.) and L. K. Wang (Stevens Institute of Technology, Hoboken, N.J.) (*University of Missouri-Rolla, Annual Conference on Energy, 4th, University of Missouri-Rolla, Rolla, Mo., Oct. 11-13, 1977*) *Journal of Environmental Sciences*, vol. 22, July-Aug. 1979, p. 23-26. 5 refs. Research supported by New York State Dept. of Environmental Conservation and Stevens Institute of Technology.

Electrical energy consumption models are developed for the unit operations/processes of pumping, screening and comminution, grit removal, sedimentation, chlorination, gravity thickening, anaerobic digestion, vacuum filtration, incineration, and diffused air flotation. The mathematical models of total heating requirements of biological wastewater treatment plants are also derived and presented. (Author)

**A79-46231** Emissions and particle-size distributions of minor and trace elements at two western coal-fired power plants equipped with cold-side electrostatic precipitators. J. M. Ondov, R. C. Ragaini, and A. H. Biermann (California, University, Livermore, Calif.) *Environmental Science and Technology*, vol. 13, Aug. 1979, p. 946-953. 35 refs. Contract No. W-7405-eng-48.

**A79-46236** Mass-energy analyses for gas-cooled fast reactor and fusion-fission hybrid reactor systems. M. R. Jonzen (General Atomic Co., Fusion Div., San Diego, Calif.) *Nuclear Technology*, vol. 45, Aug. 1979, p. 54-67. 21 refs.

Detailed mass and energy calculations have been used to study the fuel- and power-producing capabilities of a gas-cooled fast reactor and a non-optimized ignition tokamak fusion-fission hybrid reactor. Equivalent energy inputs and outputs are utilized to evaluate the performance of the reactors. The time to recover reactor inputs, system efficiencies, and lifetime net outputs are compared. Fuel production capabilities of the hybrid are contrasted with those of the gas centrifuge and gaseous diffusion uranium enrichment processes for various ore costs. Results show that fuel- and power-producing hybrid systems can compare favorably with fission breeders and isotope separation systems, particularly when utilized in U-233-fueled symbiotic systems. (Author)

**A79-46249** Study on junction properties of n-CdS/p-InP heterodiodes by using injection electroluminescence. A. Yoshikawa, O. Ishizaki, H. Kasai, and M. Nishimaki (Chiba University, Chiba, Japan) *Institute of Electronics and Communication Engineers of Japan, Transactions, Section E (English)*, vol. E62, Apr. 1979, p. 224-228. 10 refs.

The paper presents a study of the junction properties of n-CdS/p-InP heterodiodes prepared as solar cells by a close-space technique. Results of an experiment using injection electroluminescence show that these diodes have a low interface state density in deep levels at room temperature. At liquid nitrogen temperature the luminescence spectra originating from both band-to-band and free bound transitions are observed. The energy difference between the two emission peaks is found to be 67 meV, which corresponds to the activation energy of typical acceptors in InP. The internal electroluminescence quantum efficiency is 12.8% at 77 K. V. T.

**A79-46254** # Computer simulation of laser implosive compression of ADT target and analytic solutions on the shock waves and thermal waves. W. H. Tan (Academia Sinica, Optics and Fine

Mechanics Institute, Shanghai, Communist China). *Acta Physica Sinica*, vol. 28, May 1979, p. 364-376. 8 refs. In Chinese, with abstract in English

**A79-46301** Midwest Energy Conference, Chicago, Ill., November 19-21, 1978, Proceedings. Conference sponsored by the University of Illinois and U.S. Department of Energy. Edited by J. P. Hartnett (Illinois, University, Chicago, Ill.). *Energy* (UK), vol. 4, Apr. 1979, 239 p.

The conference focused on nuclear energy, energy storage and conservation, alternate energy sources, and coal. Specifically, papers were presented on the characteristics of the high power density tokamak reactor, advanced-fuel pellet approaches to inertial fusion, thermal storage efficiencies, effects of modifying heat transfer properties of indigenous sandstones, design of compressed air energy storage systems, superconductive magnetic energy storage, electro-negative chemical reactors, biomass gasification, fuels and chemicals from biomass, study of a wave energy device, and a steam process for coal gasification

A. T.

**A79-46302** Performance characteristics of the high power density, flux-conserving tokamak /FCT/ reactor. S. K. Borowski and T. Kamnash (Michigan, University, Ann Arbor, Mich.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 147-155. 15 refs. Research supported by the Electric Power Research Institute and U.S. Department of Energy.

Most of the fusion Experimental Power Reactor (EPR) and commercial power reactor designs have been limited to low beta (ratio of plasma pressure to magnetic field pressure), low power density tokamak systems. In an effort to redesign a viable, economically attractive power reactor that could meet the electric utilities needs, the flux-conserving tokamak concept has emerged as a leading contender. In this paper, we examine the operating characteristics of an FCT reactor and show that such a system would be comparable in size to an EPR but produce more than five times the fusion power. It will be seen that the FCT concept could provide the utility industry with compact reactor systems of moderate electrical output (between 500 and 1000 MWe) without requiring large extrapolations in plasma size and technology beyond that of the Tokamak Fusion Test Reactor (TFTR) currently under construction.

(Author)

**A79-46303** Advanced-fuel pellet approaches to inertial fusion. C. K. Choi, T. E. Blue, and G. H. Miley (Illinois, University, Urbana, Ill.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 157-162. 9 refs. Research supported by the Electric Power Research Institute.

Inertial confinement fusion (ICF) concepts, as compared to magnetic confinement, provide an attractive approach to burning 'advanced-fusion fuels' to achieve fusion. A key advantage of the ICF approach is that the absence of externally imposed magnetic fields avoids large cyclotron radiation losses. An important advantage of advanced-fusion fuels is that advanced fuels provide 'cleanliness' due to less neutron production and tritium handling. Present studies focus on the A-FLINT (Advanced-Fuel Layered Ignitor/Pellet Nurturing Tritium) design which consists of a D-T fueled seed surrounded by a D-layer and appropriate tamper. A heavy-ion beam accelerator is proposed to provide adequate input-energy and efficiency. The pellet design minimizes input requirements through shock ignition of the small D-T core, providing a matchhead effect. The surrounding layers provide unburned tritium to fuel subsequent pellets, eliminating the need for a lithium blanket and simplifying the reaction vessel design.

(Author)

**A79-46304** A possible route to small, flexible fusion units. G. H. Miley and J. G. Gilligan (Illinois, University, Urbana, Ill.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 163-170. 25 refs.

Conceptual design studies of a small D-H-3 field-reversed mirror fusion plant are described. If achieved, the basic unit, termed SAFFIRE, would produce a few megawatts of power. By 'stacking' of units, however, plants could be built in the 10s of megawatt size. This would make relatively clean fusion power available for applications requiring small, decentralized, power plants. (Author)

**A79-46305** Energy exchange between earth-sheltered structures and the surrounding ground. E. R. G. Eckert, T. P. Bligh, and E. Pfender (Minnesota, University, Minneapolis, Minn.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 171-181. 5 refs. NSF Grant No. AER-75-03481

A program of measurements is underway at Williamson Hall, an earth-sheltered building on the campus of the University of Minnesota. The temperature and the moisture field in the ground adjacent to the building, as well as the heat flux through the building walls, are measured continuously and recorded on magnetic tape and are thus available for evaluation. The thermal conductivities of soil samples at various moisture contents were measured with a novel, unsteady method. Temperature fields in the soil adjacent to the building were also calculated on an electronic computer using the unsteady heat-conduction equation. The paper describes the present status of this study and presents samples of the results obtained to date.

(Author)

**A79-46306** Effects on thermal storage efficiencies of modifying heat-transport properties of indigenous sandstones. R. M. Abdel-Wahed (Alexandria, University, Alexandria, Egypt), P. F. Emerson, P. L. Blackshear, Jr., and M. Riaz (Minnesota, University, Minneapolis, Minn.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 183-192. 11 refs. Contract No. EY-76-S-4009.

For conditions encountered in much of the Midwest, an extensive layer of dry sandstones protected by an impermeable limestone roof is accessible for long-term (six-month), high-temperature (T higher than 100 C) thermal energy storage. The performance of such storage beds is examined when the thermal properties of sandstones are modified so as to adjust the permeability toward an optimum in order to reduce pumping power. The thermal properties of consolidated St. Peter sandstone, dispersed St. Peter sand, and pelletized St. Peter sand are measured by several techniques. A nondimensional computer model for beds bounded by a constant temperature water table is employed to estimate the influence of thermal property manipulation of storage system performance. Disrupting the sandstone permits a substantial increase in the volume efficiency and first and second law efficiencies. Pelletizing sand into particles of approximately 1 mm diameter permits marginal further increases in performance. Disruption of the consolidated sandstone reduces the thermal diffusivity and increases the permeability. Both effects improve performance.

(Author)

**A79-46307** Energy conservation via heat transfer enhancement. A. E. Bergles, G. H. Junkan (Iowa State University of Science and Technology, Ames, Iowa), and R. L. Webb (Pennsylvania State University, University Park, Pa.). (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol. 4, Apr. 1979, p. 193-200. 28 refs. Contract No. EG-78-S-02-4649.

This paper describes work on a program directed toward assessing the prospects for development of more efficient heat-exchanger equipment. Improved equipment leads to more efficient thermal systems and more effective waste-heat recovery. Heat-transfer enhancement is a vital part of this development effort. Sources of information on heat-transfer enhancement are briefly reviewed. Applications are discussed, with emphasis on those techniques which have made the transition from the laboratory to full-scale industrial equipment. Typical reports of the benefits of enhancement are cited. Factors affecting commercial development and use are also discussed.

(Author)



**A79-46308** Design of optimum compressed air energy-storage systems. A Sharma, H H Chu (Illinois, University, Chicago, Ill.), F W Ahrens, R K Ahluwalia (Argonne National Laboratory, Argonne, Ill.), and K M Ragsdell (Purdue University, West Lafayette, Ind.) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 201-216 31 refs Research supported by the U.S. Department of Energy

Compressed air energy storage (CAES) power systems are being considered by electric utilities for load leveling application. Their economic benefit and the extent of premium fuel conservation is dependent on their design. An optimum design approach for CAES is presented in this paper. It is based on decomposition of the overall CAES plant/utility grid system into three partially-decoupled subsystems. Technical and economic models of the subsystems are used in a constrained optimization procedure. The constraints are imposed by the physical characteristics of the subsystems, by interaction among the subsystems and by the interfacing requirements imposed by the utility. To illustrate the concepts, models for the system comprising the compressor train, piping, and an aquifer reservoir have been used in the optimization procedure. Results from these studies show that substantial reductions in capital cost and total operating cost can be achieved using optimization techniques (Author)

**A79-46309** Superconductive magnetic energy storage. R W Boom and S W Van Sciver (Wisconsin, University, Madison, Wis.) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 217-223 23 refs

Technical and economic aspects of large scale superconductive magnetic energy storage are presented. The program consists of component development and detailed design leading to construction of a large superconducting magnet capable of storing 1000 to 10,000 MWh. The magnet is a single-layered segmented solenoid of about 100 m radius, and energy containment is achieved by burying the magnet underground in bedrock tunnels. Magnetic loads are transmitted from the conductor to bedrock through glass fiber reinforced composite struts, and the conductor is made of an aluminum and NbTi composite and designed for full cryogenic stability in 1.8 K superfluid helium. The Graetz bridge converts the d.c. superconducting current into an a.c. current in the three-phase power system. Economic analysis shows that superconductive magnetic energy storage is competitive with alternative large scale storage schemes for units greater than 1000 MWh size (Author)

**A79-46310** Electrogenative chemical reactors. S H Langer, S J Pietsch, and G P Sakellariopoulos (Wisconsin, University, Madison, Wis.) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 225-233 36 refs Research supported by the University of Wisconsin, Atlantic Richfield Co., DuPont de Nemours and Co., and NSF

Electrogenative processes and the design and operation of electrogenerative reactors are reviewed. These processes are electrochemical in which the exothermic energy of chemical reaction is converted to direct electric current while the required chemical product is produced. Apart from energy recovery, it is also possible to reduce capital costs for cooling to remove heat. The electrogenerative reactor which uses free electrolyte, with reactants continuously supplied over the catalytic electrodes separated by the electrolyte barrier is described, noting that selectivity and rate may be controlled by varying electrode potential and electrocatalyst. Electrogenative reactions and related thermodynamic calculations for hydrogenation, oxidation, halogenation, and hydrometallurgical reactions are discussed and the importance of electrocatalysis is illustrated. Possibilities for incorporating electrogenerative processes into existing chemical processing technology are discussed from the standpoint of conserving and recovering energy presently lost as heat. (Author)

**A79-46311** Small scale gasification of biomass - The case of corn cob gasifiers. O C Doering, III, T J O'Hare, and R M Peart (Purdue University, West Lafayette, Ind.) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 235-248 7 refs

**A79-46312** Farm-scale generation of bio-gas. P R Goodrich, R J Gustafson, K L Hauer (Minnesota, University, St. Paul, Minn.), and V Larson (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 249-261

A farm-scale research and demonstration digester has been constructed, operated and monitored on a private medium-sized swine farm. Materials handling problems have been studied. Bio-gas from the digester is used in a motor generator set to be integrated into the farmstead energy system. The digester has been monitored to determine operational characteristics, amount of energy produced and efficiency of energy production (Author)

**A79-46313** Fuels and chemicals from biomass. M R Ladisch, M C Flickinger, and G T Tsao (Purdue University, West Lafayette, Ind.) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 263-275 75 refs

Techniques of converting cellulosic materials in biomass to sugars and alcohol are reviewed. Biomass is a cellulosic material composed of alpha- and hemicellulose and lignin, is renewable and abundant, and is a reservoir of solar energy stored through photosynthesis. The yield of sugars from cellulose has been increased to 90% or greater by the Purdue process in which cellulosic material is solvent-pretreated to facilitate hydrolysis to sugars by acid or enzyme. History of cellulose conversion technology by acids and enzymes is given, and the Purdue process is described, noting the solvents used for pretreatment which produce the increased sugar and consequent alcohol yield. It is concluded that this process may alleviate the future fossil-fuel dependency of the chemical industry and that the availability, quality, and cost of glucose from the solvent pretreatment process may compare favorably with glucose derived from starch (Author)

**A79-46314** The distributed flow, below atmospheric pressure solar collector. D L Spencer and T F Smith (Iowa, University, Iowa City, Iowa) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 287-297 9 refs Research supported by the Iowa Energy Policy Council

The general concepts of the vacuum-flow, flat-plate solar energy collector are discussed and previous work reviewed. Results of recent performance and freeze-tolerance test of individual modules are presented. The problems of integrating modules of the vacuum-flow type into arrays and experience with working arrays are reported. Comments are included on the economic aspects of the use of the collector as versus conventional absorbers and on the methods of assembly of the collector (Author)

**A79-46315** An investigative study of a wave-energy device. D A Guenther, D. Jones, and D G Brown (Ohio State University, Columbus, Ohio) (*University of Illinois and U.S. Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov. 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 299-306 16 refs

The methodology and design of an offshore float device to capture power in waves is presented. Results show that a modification of a mechanical cycle can produce a significant energy increase, and a prototype device will be tested to illustrate that wave power can provide significant amounts of energy. The recovery concept presented increases the deliverable energy that can be captured from a buoyant float following the free passage of a wave, accomplished by sequential capture (preloading) and release of the float at critical stages of wave passage. It is concluded that a simple modification of a mechanical cycle can lead to a significant increase in the developed



energy, and specifically, preloading a float in the trough of a wave and releasing it to the surface near the wave crest results in a net increase in the energy which may be extracted from a wave A T

**A79-46316** **Polyelectrolyte electrets for electrical energy storage** I F Miller (Illinois, University, Chicago, Ill.) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 307-313 17 refs NSF Grant No GK-43294, Grant No NIH-GM-12013

In the study described, membrane electrets composed of mixtures of polyelectrolyte salts and hydrogen bonding materials were investigated to determine, their electric charge and electrical energy-storage characteristics It is found that membranes containing salts of polystyrene-sulfonic acid plus polyvinyl alcohol show excellent promise for electrical storage purposes (Author)

**A79-46317** **Combustion of coal particles in wall-burning swirl combustors** P M Chung (Illinois, University, Chicago, Ill.) and R S Smith (Argonne National Laboratory, Argonne, Ill.) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 315-327 16 refs Research supported by the University of Illinois and U S Department of Energy

An approximate analysis is made of the performance of the wall-burning coal combustors The results show that the swirl number plays a more important role than the char gasification chemical kinetics in determining the overall gasification rate At high pressures, the wall-burning combustors may not be as efficient as the gas-stream combustors The situation, on the other hand, may be reversed at the lower pressures (Author)

**A79-46318** **Combustion characteristics of droplets of coal/oil and coal/oil/water mixtures** C K Law, H K Law, and C H Lee (Northwestern University, Evanston, Ill.) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 329-339 7 refs Contract No EF-77-G-01-2741

The utilization of coal/oil mixtures in furnaces and boilers appears to be a viable short-to-medium range solution to partially alleviate the demand on petroleum supply with minimum combustor modifications The present investigation first demonstrates that the combustion characteristics of the coal/oil mixture droplets depend intimately on the intensity of internal circulation Rapid internal motion favors batch-distillation type vaporization which causes the coal particles to agglomerate On the other hand, slow internal motion traps the volatile components in the inner core of the rapidly-heated droplet and may eventually lead to internal boiling and subsequently fragmentation of the droplet Experimental results reveal a mixed behavior, although the degree of agglomeration is significant even at moderate levels of coal loading It is subsequently shown that the addition of small quantities of water significantly enhances the potential and intensity of droplet explosion Practical implications of the present results are also discussed (Author)

**A79-46319** **Combustion of single coal particles in a jet** K W Ragland and C A Weiss (Wisconsin, University, Madison, Wis.) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 341-348 13 refs

Experimental data on the behavior and combustion rates of individual coal particles aerodynamically suspended in a heated jet to simulate fluidized bed conditions are presented Tests of bituminous, sub-bituminous, and lignite coals from 2 to 12 mm in size were conducted at jet temperatures of 705 and 816 C in air and air diluted with equal amount of nitrogen The ignition time delay varied from 2 to 44 sec, and the devolatilization time extended up to 80 sec and varied as the particle initial diameter to the 1.5th power The total burn time extended to 740 sec, was independent of coal type and temperature, and varied as the square of the size and inversely with

the oxygen concentration The burning rate decreased with time and could not be explained by a square law relationship, and it was higher than literature values at lower convective velocities indicating the importance of oxygen diffusion A T

**A79-46320** **Heat transfer between a fluidized bed and an immersed vertical U-tube** S C Saxena (Illinois, University, Chicago, Ill.) and A Chatterjee (Illinois, University, Chicago, Ill., Indian Institute of Technology, Bombay, India) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 349-356 7 refs NSF Grant No ENG-77-08780

The design details of a 0.254m stainless steel cylindrical fluidized bed pilot plant facility, whose fabrication, installation and testing have been recently completed, are described It primarily consists of a fluidized-bed reactor, fluidizing air supply system, solids feeder, off-gas cleaning and exhaust system, and cooling water supply system for heat-transfer tubes provided in the bed in the freeboard sections The plant is operated at ambient pressure in the temperature range 300-600 K, both in the batch and continuous modes for solids feed Bed-pressure drop measurements as a function of fluidizing velocity for two different bed heights reveal that the quality of fluidization is good Similar experiments have been conducted with the continuous solids feed The heat-transfer coefficient between the bed and an immersed stainless steel U-tube is measured as a function of fluidizing air velocity at five different temperatures The effects on bed-to-tube heat-transfer rate of solids feed rate, bed height, air-flow rate, and bed temperature are examined All of these observed variations are interpreted in terms of the solids mixing and bubble mechanics in the bed (Author)

**A79-46321** **A steam process for coal gasification** S L Soo and R T Gibbs (Illinois, University, Urbana, Ill.) (*University of Illinois and U S Department of Energy, Midwest Energy Conference, Chicago, Ill., Nov 19-21, 1978*) *Energy* (UK), vol 4, Apr 1979, p 357-364 14 refs Research supported by Pullman Kellogg

The paper studies a gasification process which uses steam as a reactant as well as a heat source to generate hydrogen, carbon monoxide, and methane by using carbon in coal as a reducing agent It is shown that economical operation can be maintained by using a large excess in steam at 1300 C level (more than 4 mole of H<sub>2</sub>O to 1 mole C) The steam is produced by burning a fraction of the product gas in a pebble-heater system A high percentage of H<sub>2</sub> can be produced in the product gas without the need for shift conversion Other components are CO, CH<sub>4</sub>, with CO<sub>2</sub> and H<sub>2</sub>S removed by absorption, with excess H<sub>2</sub>O removed by condensation, of varying percentages dependent on reactor temperature and pressure Char-coal and Illinois No. 6 coal were gasified in the experimental facility at pressures up to 10 atm It is noted that a steam temperature of 1300 C or higher can be achieved via a pebble bed heater with cored bricks or a silicon carbide tubular heat exchanger (Author)

**A79-46432 #** **Volcanology** T Simkin (Smithsonian Institution, Washington, D C.) *Reviews of Geophysics and Space Physics*, vol 17, June 1979, p 872-887 405 refs

Volcanology in the 1970s has expanded greatly both in size and in scope The most striking volcanological advances in the 1970s have been in the investigation of deep sea volcanism Additional recent expansion in 1970s volcanology has come with interdisciplinary approaches the application of physics and chemistry to eruptive processes, the meteorological effects of explosive eruptions, the geophysical delineation of subsurface magma bodies, and the increasing interaction with archeological problems The present review proceeds from effusive rift volcanism, through intraplate activity, to the explosive volcanism of island arcs and continental margins An extensive reference bibliography is presented S D.

**A79-46433 #** **Geothermal systems and their energy resources** D E White and M Guffanti (U S Geological Survey, Menlo Park, Calif.) *Reviews of Geophysics and Space Physics*, vol 17, June 1979, p 887-902 497 refs

Geothermal systems of all types are reviewed, with particular reference to U S systems that are most likely to be utilized as energy sources. An evaluation of the systems leads to the conclusion that, although a vast quantity of thermal energy is contained in crustal rocks at temperatures high enough for electrical generation, depths are commonly too great for economic production in near future. Igneous-related systems with high thermal gradients are seen to provide attractive targets for hot dry rock technology. The feasibility of extracting energy directly from deep magma sources is being studied, but the problems appear to be formidable. V P

**A79-46521 # Energy production by photoelectrochemical processes.** R Memming (Philips GmbH, Forschungslaboratorium, Hamburg, West Germany) *Philips Technical Review*, vol 38, 1978-1979, no 6, p 160-177. 43 refs

A survey of research on photoelectric chemical solar cells is presented. Such cells, consisting of a semiconductor electrode, an electrolyte, and a metal counter-electrode, generate power by light excitation similar in nature to that in p-n junctions. It is noted that a regenerative cell suitable for power generation can be made if a redox system is added to the electrolyte. Its function and construction are described in terms of the energy levels. Consideration is given to problems that arise because of side reactions such as anodic dissolution. In addition, the stability problem and the selection of suitable semiconductor materials are discussed in detail and photo-electrolysis cells that can be applied for the production of hydrogen, are described. M E P

**A79-46526 Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings.** Workshop sponsored by the U.S. Department of Energy and Electric Power Research Institute. Edited by E F Clark and F de Winter (Altas Corp., Santa Cruz, Calif.) Santa Cruz, Calif., Altas Corp., 1979. 465 p

The work deals with analytic and experimental studies on the integration of wind generation into electric utility networks. Overviews of major wind program elements are included, covering activities in wind turbine generators (WTG) hardware design and development, wind energy resource assessment and environmental issue assessment. The paper covers the following sessions: (1) wind energy technology overview, (2) wind generation value in electric utility systems, (3) large wind turbine generator operation and status, and (4) network interaction analyses. Consideration is given to economic requirements and value analysis, and operational experience and status. V T

**A79-46527 \* # Large horizontal axis wind turbine development.** W H Robbins and R L Thomas (NASA, Lewis Research Center, Cleveland, Ohio). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings.

Santa Cruz, Calif., Altas Corp., 1979, p 50-70, Discussion, p 71, 72

The paper presents an overview of the NASA activities in large horizontal axis wind turbine development. First generation technology large wind turbines (Mod-0A, Mod-1) have been designed and are in operation at selected utility sites. Second generation machines (Mod-2) are scheduled to begin operations on a utility site in 1980. These machines are estimated to generate electricity at less than 4 cents/kWh when manufactured in modest production rates. Meanwhile, plans are being made to continue developing wind turbines which can meet the cost goals of 2 to 3 cents/kWh. V T

**A79-46528 # Economic overview of vertical axis wind turbines.** W N Sullivan (Sandia Laboratories, Albuquerque, N Mex.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p 73-81, Discussion, p 82. Contract No. AT(29-1)-789

An economic overview of vertical axis wind turbines (VAWT) is presented. The most favorable systems investigated can provide utility electricity with a cost in the range of 4-6 cents/kWh with existing technology. The cost of energy decreases as VAWT rotor size increases up to the largest system investigated (1600 kW). This is due primarily to the presence of costs which vary slowly or not at all with rotor size. These costs are associated with operation, maintenance, and automatic control hardware. These slow-varying costs dominate the smaller systems and tend to limit their cost effectiveness. The cost of energy of all size systems is sensitive to the median annual windspeed, while the cost of larger systems is sensitive to the wind exponent. V T

**A79-46529 # Wind resource assessment status.** L L Wendell (Battelle Pacific Northwest Laboratories, Richland, Wash.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p 83-94. 8 refs

Wind resource assessment activities are discussed including national, northwest, and other regional assessments, techniques for regional assessments, and siting methodologies. It is noted that features indicating high wind energy potential are: (1) gaps, passes, and gorges in areas of frequent strong pressure gradients, (2) long valleys extending parallel to prevailing wind directions, (3) high elevation plains and plateaus, and (4) exposed ridges and mountain summits in areas of strong geostrophic winds. Features that indicate low wind energy potential are: (1) valleys perpendicular to the prevailing wind direction, (2) sheltered basins, and (3) short and/or narrow valleys and canyons. V T

**A79-46530 # Environmental issues assessment.** T R Kornreich and R J Kottler, Jr (JBF Scientific Corp., Arlington, Va.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p 95-109. 8 refs

Electromagnetic interference, sound intensity, safety, siting impacts, ecological concerns, public acceptance, and legal and institutional issues represent potential environmental constraints to the wide-scale implementation of wind turbine systems. Of these potential problems, electromagnetic interference and certain legal and institutional issues are of the most concern. The major environmental problem (interference with television reception) is studied in detail for large-scale horizontal axis wind systems. Legal and institutional considerations (such as zoning, building and safety codes) may pose a barrier to prospective wind turbine use in urban and suburban areas. V T

**A79-46531 # Requirements assessment of wind power plants in electric utility systems.** W D Marsh (General Electric Co., Schenectady, N Y). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p 110-124, Discussion, p 125, 126. Research supported by the Electric Power Research Institute.

A methodology developed for studying the performance and economic requirements of wind plants when applied to electric utility power systems is discussed. The adopted total system cost method of analysis consists of three models: the wind performance model, the reliability model, and the production model. The methodology was exercised in several actual utility systems to confirm and demonstrate its capability. The procedure for studying the application of wind power plants in specific utility systems consisted of three steps: calculate the performance and cost of the system as planned without new generation, substitute wind for conventional generation, and compare total system costs with the base cost. V T

**A79-46532 # Wind energy systems application to regional utilities.** E E Johanson and M K Goldenblatt (JFB Scientific Corp.,

Wilmington, Mass.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 127-154, Discussion, p 155-157 Contract No. EX-76-C-01-2438

A generic planning process is developed to determine the feasibility of utilizing wind energy conversion systems (WECS) as part of the future mix of equipment. The approach used is to establish the worth or value, of WECS by adding them to the utility mix at zero cost and determining what savings the utility would realize from its conventional sources, due to the presence of the WECS. The value of the WECS is established by determining, on an hour-by-hour basis, the wind availability, and what portion of the load it satisfied. The wind is treated as a negative load and utilized to satisfy as much of the utility load as it can. The mix of conventional sources is then optimized to satisfy the remaining load. The developed generic planning process was applied to two specific cases and comparisons were made between the results obtained for these cases. V T

**A79-46533 # Wind energy central station power generation in the Southwest and Southeast.** D H Guild (Stone and Webster Engineering Corp., Boston, Mass.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 158-170

The Southwest Project and Southeast Regional Assessment Study showed that wind energy will play a minor role in electric power generation in these regions. This is primarily due to lack of good wind resources - as compared to the Northwest and Northeast coastal regions. While the wind resources in the Southwest are better, particularly in the Texas Panhandle area and mountainous regions, than in the Southeast, all these resources are remote from existing transmission lines and load centers. In all cases, the wind resources need to be quantified at specific sites in order to determine its actual value for possible central station use. Conceptual design and cost estimates of a wind power central station are considered along with system integration studies. V T

**A79-46534 # Electric utility application of WECS in an island location.** C A Lindley (Aerospace Corp., El Segundo, Calif.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 171-187, Discussion, p 188, 189. Research supported by the U S Department of Energy

An electric utility application study of wind energy conversion systems (WECS) in an island location shows economically high wind energy levels in several areas of Oahu, Hawaii, and low variability of wind speeds. The study includes a synthetic design exercise in WECS site selection, field layout, and performance estimation. A comprehensive set of siting factors and criteria useful in future site selection is developed and evaluated. A scenario WECS design used to estimate Oahu WECS performance forms the skeleton of a methodology for wind resource survey, WECS application evaluation, and WECS field design layout for mountainous terrain wind resources. Opinions on the most likely path of practical commercial exploitation of WECS are presented. V T

**A79-46535 # Wind/hydro generation assessment.** A W. Watts (U S Bureau of Reclamation, Denver, Colo.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 190-203, Discussion, p 204

A three-year study of the feasibility of integrating wind turbine generators with an existing Federal hydroelectric system is discussed. As part of the study, one large wind turbine generator, in the megawatt range will be installed to verify the integration concept and provide data for environmental studies. The wind resource is in an

area near Medicine Bow, Wyoming, the hydroelectric system is the Colorado River Storage Project. A computer model of the Medicine Bow wind regime was developed to simulate an average wind year by providing the wind speed each hour in the year. It is shown that the high level of on-peak generation at the site makes this resource compatible for integration with the hydrosystem. V T

**A79-46536 # Distributed wind generation assessment.** J L Oplinger (General Electric Co., Schenectady, N Y.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 205-214

Development of a methodology for utility evaluation of distributed wind power systems in their respective service areas is discussed. System definition includes selection of three actual utility systems in geographic areas having wind, climatic, and topographical characteristics suitable for application of wind power plants. Then, several geographical areas for wind power plant siting are selected within each utility service area. After characteristic hourly wind data are developed for the specific areas, the system definition work continues with specification of candidate wind turbine generators (WTG) for each wind regime. The rating of individual wind turbine generators and the number to be aggregated for a given candidate system will depend upon the characteristics of the utility and the particular site involved. V T

**A79-46537 \* # Utility operational experience on the NASA/DOE Mod-OA 200 kW Wind Turbine.** J C Glasgow and W H Robbins (NASA, Lewis Research Center, Cleveland, Ohio) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 215-245, Discussion, p 246, 247. 6 refs

The Mod-OA 200 kW Wind Turbine was designed and fabricated by the Lewis Research Center of the NASA under the direction of the U S Department of Energy. The project is a part of the Federal Wind Energy Program and is designed to obtain early wind turbine operation and performance data while gaining initial experience in the operation of large, horizontal axis wind turbines in typical utility environments. On March 6, 1978, the Mod-OA wind turbine was turned over to the Town of Clayton Light and Water Plant, Clayton, NM, for utility operation and on December 31, 1978 the machine had completed ten months of utility operation. This paper describes the machine and documents the recent operational experience at Clayton, NM. (Author)

**A79-46538 # MOD-1 wind turbine generator program status report.** R H Poor (General Electric Co., Philadelphia, Pa.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 248-282

The paper reports a status of the MOD-1 wind turbine generator program for the first megawatt class machine WTG. The MOD-1 WTG is described with attention drawn to its rotor design, drive train, power generation/control system, nacelle structure, yaw drive, weight, and tower and ground equipment. WTG performance and economics are considered along with factory assembly and test, site preparation, and installation. During further blade installation, first rotation, and system testing data and operating experience will be obtained for developing future machines. V T

**A79-46539 # Cuttyhunk Island installation, WTG Energy Systems, Inc., MP1-200 control system design.** M Rose (WTG Energy Systems, Inc., Angola, N Y.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Altas Corp., 1979, p 283-296

A system for controlling the speed of a wind generator is described, which utilizes load modulation with a fixed pitch rotor

configuration Wind turbine description is given along with control system equipment, supervisory and subsystem controls The MP1-200 wind turbine installed on Cuttyhunk Island, Massachusetts utilizes a three bladed, 80 feet diameter rotor. All the major parameters of the system operation are monitored and displayed on the CRT and teletype. Cumulative data, such as wind velocity, kilowatt hours, kiloVAR hours, and machine hours are stored in memory and printed at periodic intervals The performance of the wind turbine is discussed and modifications of the basic design are outlined V.T

**A79-46540 # A fully interconnected wind system.** W. A. Frederick, J. A. Miller, and J. E. Pfluger (Pennsylvania Power and Light Co., Allentown, Pa.) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings.

Santa Cruz, Calif., Altas Corp., 1979, p. 297-309, Discussion, p. 310, 311.

A wind turbine generator (WTG) with a full three-phase connection to the electrical distribution system was installed at the Hazleton site, Pennsylvania. The WTG consists of a 40-foot tower, 45-foot-diameter rotor, gearbox, 45 kW three-phase alternator, control panel, and three-phase rectifier. The ac output from the generator is rectified to dc and fed to a synchronous inverter. The line commutated synchronous inverter maintains synchronism to the utility grid and fires pulses of power each half cycle into the established 60 Hz utility sine-wave form. A 500 ampere-hour battery is connected to the dc bus for energy storage and to provide a steady load to help regulate the dc voltage and speed of the WTG. Plans for WTG testing and engineering analysis are considered V.T.

**A79-46541 # Status of the Southern California Edison Company 3 MW wind turbine generator (WTG) demonstration project.** R. L. Scheffler (Southern California Edison Co., Rosemead, Calif.). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 312-315, Discussion, p. 316, 317.

**A79-46542 # The MOD-2 wind turbine.** J. E. Lowe and W. W. Engle (Boeing Engineering and Construction Co., Seattle, Wash.). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 318-331, Discussion, p. 332, 333.

The development of the 300-ft diameter, 2.5 MW wind turbine electrical generator MOD-2 is presented and the outlook for its future commercial application is discussed. The ground rules for the design of the turbine included a horizontal axis configuration, an energy cost of 2 to 4 cents/kWh and a 30-year service life. The determination of system dimensions, component ratings and characteristics in the conceptual and preliminary design phases is discussed. Computer codes and alternative design configurations were verified by means of a wind tunnel test program. Design and operating characteristics of the turbine components, including the teetering rotor, low-natural-frequency tower, nacelle, electrical system and the control system and the system weight, performance and maintenance characteristics are presented. Depending on the completion of a number of evaluative and production tasks, a large-scale MOD-2 unit could be produced by 1984 A L W

**A79-46543 # Magdalen Islands VAWT field test.** P. South (National Science and Engineering Research Council, Ottawa, Canada) and A. Watts (Hydro-Quebec, Institut de Recherche, Varennes, Canada) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 334-351, Discussion, p. 352, 6 refs

In the spring of 1977, an experimental large vertical axis wind turbine (VAWT) was installed in the Magdalen Islands. The main

objectives of the project are installation, operation and evaluation of the VAWT. The turbine has been operated at up to about 80 percent of design rpm. The information presented includes data from some of the 31 rpm tests which provide some insight into how the turbine will perform at its rated speed. Also, descriptions of the mechanical and electrical systems, foundations and installation method are given along with some estimates of energy production. S D

**A79-46544 # Summary report on the collapse of the Magdalen Islands wind turbine.** R. J. Templin (National Science and Engineering Research Council, Ottawa, Canada) and R. D. McConnell (Hydro-Quebec, Institut de Recherche, Varennes, Canada) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 353-365

**A79-46545 # Wind energy conversion system transient performance analysis.** W. W. Price (General Electric Co., Schenectady, N.Y.) and S. L. Macklis (General Electric Co., Valley Forge, Pa.). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 366-376, Discussion, p. 377

**A79-46546 # Impact of storm fronts on utilities with WECS arrays.** R. A. Schlueter, G. L. Park, H. Modir, J. Dorsey, and M. Lotfalian (Michigan State University, East Lansing, Mich.). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 378-387. Research sponsored by the U.S. Department of Energy

The research work described was aimed at determining the impact of significant changes in WECS generation on automatic generation control (AGC) regulation, economic dispatch, and governor frequency regulation. The results show that AGC saturation problems will occur in the presence of large simultaneous storm-induced WECS-generation and load changes. This problem is alleviated if spinning reserve margins are increased. An improvement in response to WECS generation changes is shown to be possible by including a higher percentage of faster responding units. A cyclic phenomenon was shown to take place on nuclear units if the generation changes on echelons are sufficiently large to cause frequency deviations that exceed governor deadband on the unit under consideration. V.P.

**A79-46547 \* # Lewis Research Center studies of multiple large wind turbine generators on a utility network.** L. J. Gilbert (NASA, Lewis Research Center, Cleveland, Ohio) and D. M. Triezenberg (Purdue University, West Lafayette, Ind.). In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings. Santa Cruz, Calif., Altas Corp., 1979, p. 388-402, 5 refs.

A NASA-Lewis program to study the anticipated performance of a wind turbine generator farm on an electric utility network is surveyed. The paper describes the approach of the Lewis Wind Energy Project Office to developing analysis capabilities in the area of wind turbine generator-utility network computer simulations. Attention is given to areas such as, the Lewis Purdue hybrid simulation, an independent stability study, DOE multiunit plant study, and the WEST simulator. Also covered are the Lewis mod-2 simulation including analog simulation of a two wind turbine system and comparison with Boeing simulation results, and gust response of a two machine model. Finally future work to be done is noted and it is concluded that the study shows little interaction between the generators and between the generators and the bus M.E.P

**A79-46548 # Field experience with wind turbine generator operation in utility systems.** T. W. Reddoch (Tennessee, University,

Knoxville, Tenn) In Workshop on Economic and Operational Requirements and Status of Large Scale Wind Systems, Monterey, Calif., March 28-30, 1979, Proceedings Santa Cruz, Calif., Alta Corp., 1979, p. 403-413

The present paper deals with three of the seventeen candidate sites which have been chosen by the Federal Wind Energy Program to study means of integrating wind technology into electric power systems. These sites are Clayton, N. Mex., Culebra, P.R., and Block Island, Rhode Island. Each site receives a DOE/NASA Mod O-A which is rated at 200 kW in a 22.4 mph wind at 30 m above ground level. An attempt is made to quantify some of the utility experience with the Mod O-A recorder to date. V P

**A79-46660 #** Conserving energy via cogeneration. W. B. Wilson (General Electric Co., Schenectady, N.Y.) *Mechanical Engineering*, vol. 101, Aug. 1979, p. 20-27

Consideration is given to the problem of whether industrial plants can realize a return on investment (ROI) with the installation of a cogeneration system, as opposed to a system with process boilers and purchased electric power. Topics covered include low-level heat recovery, waste gas-flow requirements for steam generation and inlet steam pressure effects. Data are also given showing capital requirements and annual operating costs of process boilers versus steam turbine cogeneration, along with the effect of investment tax credit and depreciation allowances on discounted rate of return. It is concluded that for cogeneration projects with a typical 4 or 5 yr gross payout period, such tax incentives should significantly increase the number that will be implemented. M E P

**A79-46665** Dynamic aspects of solid solution cathodes for electrochemical power sources. S. Atlung, K. West, and T. Jacobsen (Danmarks Tekniske Højskole, Lyngby, Denmark) *Electrochemical Society, Journal*, vol. 126, Aug. 1979, p. 1311-1320. 20 refs. Research supported by the Danish Council for Technical Scientific Research.

This paper considers the interaction between requirements of battery systems based on alkali metal anodes and solid solution cathodes with electrochemical and constructional factors. It postulates that the energy at a given load is limited by saturation of cathode particle surface layers with cations, and that saturation time is determined by cation and electron diffusion into the host lattice. Expressions are developed for plane, cylindrical, and spherical particles, giving the relation between the battery load and the amount of cathode material utilized before saturation. Cathode performance is described by the particle shape and the ratio of discharge time at 100% cathode utilization to the time constant for diffusion through the cathode particles. The properties of plane or few particle layer cathodes are examined in relation to traction requirements on the basis of estimated parameters for the Li/TiS<sub>2</sub> couple with LiClO<sub>4</sub>-propylene carbonate electrolyte. Limiting currents in the electrolyte are discussed, and a relation between the maximum particle size and electrode spacing is derived. A T

**A79-46717 #** Turbulence dynamics in MHD plasmas. M. Martinez Sanchez (MIT, Cambridge, Mass.) and Y. Yam. *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 12th, Williamsburg, Va., July 23-25, 1979, Paper 79-1538*. 12 p. 14 refs. Contract No. EF-76-C-01-2215.

Linearized solutions are obtained for the evolution of low magnetic Reynolds number turbulence in two cases: (1) homogeneous turbulence, non-zero Hall effect, and (2) mean flow shear, without Hall effect. It is shown that the presence of the Hall effect reduces turbulence damping, and redistributes it angularly so as to approach isotropy rather than two-dimensionality. In the presence of shear, the ratio of Reynolds stress to kinetic energy is reduced by the magnetic interaction for electrode walls, but increased for sidewalls. The results can be of use in improved models of turbulent boundary layers in large MHD channels. (Author)

**A79-46757** Vapor-turbine units with organic working fluids and prospects for their use in solar power generation. Survey. V. A. Grilikhes, M. M. Grishutin, and V. S. Evseev. (*Geliotekhnika*, no. 4, 1978, p. 3-18) *Applied Solar Energy*, vol. 14, no. 4, 1978, p. 1-12. 43 refs. Translation.

The basic characteristics of cycles and energy converters for Rankine-cycle electric energy systems with organic heat-exchange fluids are surveyed. Consideration is also given to the basic design features of such systems, with emphasis on the heat exchange equipment (steam generators, regenerators, and condensers). The application of such organic systems to the production of electric power from low-potential heat sources - solar radiation, geothermal waters, and industrial waste heat - is considered. It is found that the use of organic heat-exchange fluids will lead to considerable cost-savings. B J

**A79-46758** Thermodynamic analysis of combined GTP-TEG solar energy converter. L. M. Drabkin (Tashkentskii Institut Zheleznodorozhnogo Transporta, Tashkent, Uzbek SSR) (*Geliotekhnika*, no. 4, 1978, p. 19-22) *Applied Solar Energy*, vol. 14, no. 4, 1978, p. 13-16. Translation.

Consideration is given to the thermodynamic cycle of a solar energy system consisting of a thermoelectric generator connected to a gas turbine. Expressions are obtained for the efficiency and specific area of the refrigerator-radiator of such a system. This combined scheme is compared with a Brayton-cycle system with respect to optimization in terms of efficiency and specific area. B J

**A79-46759** Optimization of exponential alloying impurity distribution in semiconductor photoconverter base. V. M. Evdokimov and Iu. D. Lisovskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no. 4, 1978, p. 23-29) *Applied Solar Energy*, vol. 14, no. 4, 1978, p. 17-22. 17 refs. Translation.

A theoretical analysis is presented of the effect of the uniform electric field produced by an exponential distribution of dopants in the base of a photocell of finite thickness on the accumulation of charge carriers. It is assumed that the mobility and lifetime of carriers depend in power-law fashion on dopant concentration. An optimal field strength is determined and the dependence of the field on the parameters of the semiconductor and the wavelength of incident light is considered. B J

**A79-46760** Influence of temperature on operational parameters of pCdTe-nCdS film photoconverters. S. A. Azimov, Sh. A. Mirsagatov, D. T. Rasulov, and N. Iunusov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no. 4, 1978, p. 30-32) *Applied Solar Energy*, vol. 14, no. 4, 1978, p. 23-25. Translation.

**A79-46761** Solar energy thermoreceiver with selective coating and vacuum thermoinsulation. G. Ia. Umarov, V. S. Trukhov, U. Kh. Gaziev, T. Baimatov, T. Z. Abidov, and Iu. E. Kluchevskii (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no. 4, 1978, p. 46-50) *Applied Solar Energy*, vol. 14, no. 4, 1978, p. 37-40. 8 refs. Translation.

The paper describes two design modifications of a solar-thermal-radiation detector with selective coating and screening vacuum insulation which operates reliably up to temperatures of 400°C. A method for calculating the operational characteristics of the detector is presented. Curves reflecting the dependence of thermal losses and efficiency on detector temperature for different modifications of the detector system and different solar energy densities are presented. B J

**A79-46896** Application of extruded porous materials from sintered nickel powder as fuel cell electrodes I M Fedorchenko, V S Pugin, P A Kornienko, D A Tkalenko, and L G Voloshina (Akademiia Nauk Ukrainskoi SSR, Institut Problem Materialov deniia, Kievskii Politekhnikheskii Institut, Kiev, Ukrainian SSR) (Poroshkovaia Metallurgiiia, Mar 1979, p 38-40) *Soviet Powder Metallurgy and Metal Ceramics*, vol 18, no 3, Aug 1979, p 174, 175 Translation

**A79-46904** Investigation of the photoelectric characteristics of high-resistivity silicon photoconverters. N M Bordina, T M Golovner, G M Grigor'eva, K N Zviagina, L B Kreinin, and N A. Milovanova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 6, 1978, p 3-11) *Applied Solar Energy*, vol 14, no 6, 1978, p. 1-8 7 refs Translation

**A79-46905** The effect of errors in their shape on the characteristics of ellipsoidal concentrators of radiant energy. L Ia Paderin (*Geliotekhnika*, no 6, 1978, p 12-15) *Applied Solar Energy*, vol 14, no 6, 1978, p. 9-11 Translation

**A79-46906** Accelerated tests of coatings R A Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektiro-Konstruktorskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) (*Geliotekhnika*, no 6, 1978, p 16-22) *Applied Solar Energy*, vol 14, no 6, 1978, p 12-17 11 refs Translation

The application of an accelerated test method based on the so-called physical principle of reliability to accelerated life testing of the coatings for solar concentrators is considered. Considerable simplification of the method is achieved by assuming a linear form for the function relating the service life of the object to its operating regime. P T H

**A79-46907** Control of the radiant flux of high-temperature solar-energy installations with respect to two parameters. V V Afian and A V Vartanian (*Geliotekhnika*, no 6, 1978, p 23-25) *Applied Solar Energy*, vol 14, no. 6, 1978, p. 18-20 Translation

The principles of controlling a high-temperature solar installation with parabolic concentrator by means of simultaneous control over the power and density of the radiant flux at the center of the focal plane are developed. It is shown that by this method of power control there is practically no energy redistribution in a circle of radius equal to 0.001 times the ratio of the focal parameter of the parabola generator to the mirror precision measure P T H

**A79-46908** Production and use of rolled-welded panels of aluminum alloys for solar water heaters of hot water supply and cooling systems N I Koriagin, Iu M Sigalov, Iu N Malevskii, and A I Malykhin (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no 6, 1978, p 26-31) *Applied Solar Energy*, vol 14, no 6, 1978, p 21-25 Translation

**A79-46909** Investigation of the temperature distribution over the width of the screen of low-temperature solar water heaters with tubular heat receivers. G Ia Umarov, R R Avezov, and N A Kakharov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 6, 1978, p 41-46) *Applied Solar Energy*, vol 14, no 6, 1978, p 33-37 7 refs Translation

**A79-46910** Investigation of the spectral characteristics of metallized polymer films for making solar concentrators. A Iazkulyev, A A Trofimova, N S Galkina, and M Kholeva (Akademiia Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) (*Geliotekhnika*, no 6, 1978, p 53, 54) *Applied Solar Energy*, vol 14, no 6, 1978, p 44, 45 5 refs Translation

**A79-47019** Photovoltaic properties of metal-free phthalocyanines. I - Al/H<sub>2</sub>Pc Schottky barrier solar cells R O Loutfy and J H Sharp (Xerox Research Centre of Canada, Mississauga, Ontario, Canada) *Journal of Chemical Physics*, vol 71, Aug 1, 1979, p 1211-1217 17 refs Research supported by the National Research Council of Canada

The photovoltaic properties of Schottky barrier solar cells, made by dispersing particles of the x form of metal-free phthalocyanine in a polymer binder and sandwiching between NESA (SnO<sub>2</sub>/Sb) and aluminum electrodes, were investigated. A power conversion efficiency of over 6% for transmitted light at low power densities was obtained for monochromatic irradiation at 670 nm, and at peak solar power density of 1400 W/sq m it decreases to 0.01%. The decrease in power conversion efficiency with intensity was attributed to a space charge limitation due to nonlinear resistance. Analysis of the action spectra of these devices showed the formation of a thin photoactive depletion region at the semiconductor/metal interface, and they are capable of capturing 30% of the solar spectrum within the photoactive region. The effect of pigment loading, cell thickness, light intensity, binder materials, doping, and dye sensitization were studied. A T

**A79-47050** The physics of solar cells K W Boer (Delaware, University, SES, Inc., Newark, Del.) *Journal of Applied Physics*, vol 50, Aug. 1979, p 5356-5370 51 refs Research supported by the U.S. Department of Energy and SES

The photovoltaic mechanism is analyzed with special attention to the boundary conditions between emitter and junction. In frontwall cells, these boundary conditions are rather simple and permit a transparent analysis. They connect the current, determined by the emitter/junction boundary, with the potential drop in the junction, determined by the same condition, and yield the current-voltage characteristic without invoking the superposition principle. The chemistry of the interlayer between the emitter and the junction modifies this characteristic when causing major interface recombination, resulting in a potential deformation. Such behavior is analyzed in more detail for the example of CdS/Cu<sub>2</sub>S and Cd(zn(1-z)S/Cu<sub>2</sub>S solar cells. Substantially improved agreement between the results of this theory and experiment is reached. (Author)

**A79-47051 \*** A simple theory of back-surface-field (BSF) solar cells O von Roos (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Journal of Applied Physics*, vol 50, Aug 1979, p 5371-5374 Research sponsored by the U.S. Department of Energy

An earlier calculation of the I-V characteristics of solar cells contains a mistake. The current generated by light within the depletion layer is too large by a factor of 2. When this mistake is corrected, not only are all previous conclusions unchanged, but the agreement with experiment becomes better. Results are presented in graphical form of new computations which not only take account of the factor of 2, but also include more recent data on material parameters. (Author)

**A79-47054** Study of the interface changes during operation of n CdTe-electrolyte solar cells C Vazquez Lopez, F Sanchez-Sinencio, J S Helman, A Lastras-Martinez (Instituto Politécnico Nacional, Mexico City, Mexico), P M Raccah (Illinois University, Chicago, Ill.), R Triboulet (CNRS, Laboratoire de Physique des Solides, Meudon Bellevue, Hauts-de-Seine, France), and J. L. Peña *Journal of Applied Physics*, vol 50, Aug 1979, p 5391-5396. 11 refs Research supported by the Consejo Nacional de

Ciencia y Tecnología, Secretaría de Patrimonio y Fomento Industrial, and NSF

Deterioration of nCdTe-electrolyte solar cells was studied by Auger electron spectroscopy, electroluminescence (EL) analysis, electroreflectance (ER) spectroscopy, and spectral response. It was shown that the failure mechanism involves out-diffusion of Cd(2 plus), leaving behind a rich Te layer and a p-type CdTe region. ER and EL studies also show the existence of the p-type region, and the evolution of the ER spectra as the p-type region develops was analyzed. This method makes possible easy control and optimization of the p-n junction growth parameter. The influence of the Te layer on the cell performance was determined from spectral response measurements. A T

**A79-47060 Neon spectral line broadening as a diagnostic for compressed laser-fusion targets** J M Auerbach, D S Bailey, S S Glaros, L N Koppel, Y L Pan, L M Richards, V W. Slivinsky, and J J Thomson (California, University, Livermore, Calif.) *Journal of Applied Physics*, vol 50, Aug 1979, p 5478-5483 18 refs Contract No W-7405-eng-48

Experiments have been conducted on the JANUS laser system to measure fuel density in imploded laser fusion targets filled with deuterium, tritium, and neon. An X-ray crystal spectrometer was used to record the line emission of the 1s-2p line of the Ne(+g) ion. Simultaneous measurement of the linewidth and the neutron yield indicated that symmetrically irradiated exploding pusher targets reached fuel densities of approximately 1 g/cu cm. (Author)

**A79-47062 Ultrafine nickel particles for photothermal conversion of solar energy** G A Niklasson and C G Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden) *Journal of Applied Physics*, vol 50, Aug 1979, p 5500-5505 47 refs

A study of gas-evaporated Ni particles produced under conditions such that NiO coatings separate the metal cores from one another, and used as a model substance simulating the properties of Ni grain containing photothermal converting surfaces is presented. Ni particles with maximum mean diameters of 10 microns were produced by inert-gas evaporation onto KBr plates, and heating in air to 400C produced electrical decoupling of the grains by formation of NiO pellicles. Transmittance measurements in the 0.3 to 30 micron range showed excellent spectral selectivity with high absorption over the solar spectrum and low absorption in the thermal infrared range. These properties prove that coatings with Ni grains are useful for the photothermal conversion of solar energy. A theoretical analysis of the optical properties of aggregated spherical particles with dielectric shells was made using an extended effective-medium theory based on the Maxwell Garnett approach. A T

**A79-47063 Collection efficiency measurements on a-Si H solar cells.** R S Crandall, R Williams, and B E Tompkins (RCA Laboratories, Princeton, N J.) *Journal of Applied Physics*, vol 50, Aug 1979, p 5506-5509 11 refs Research supported by RCA, Contract No EY-76-C-03-1286

The collection efficiency of a-Si H Schottky-barrier solar cells is measured and the discrepancy between actual and maximum efficiencies is investigated. The collection efficiency of layers of a-Si H with platinum barrier contacts was determined as a function of barrier thickness or depletion width by varying the applied voltage. Bias voltage-diode current curves for a Pt-a-Si H diode reveal a higher fill factor in blue light (400 nm), which is absorbed near the surface, than in red light (630 nm), which is absorbed in the barrier region. In blue light the collection efficiency is found to be independent of barrier thickness, indicating a minority carrier diffusion length much greater than the barrier thickness. In blue light, however, the collection efficiency is found to vary strongly with barrier thickness, suggesting a field-dependent carrier-generation process which would dramatically reduce collection efficiency at an illumination of one sun. A L W

**A79-47071 The race for unlimited energy** G N Patterson (Toronto, University, Downsview, Ontario, Canada). Research sponsored by the University of Toronto Downsview, Ontario, Canada, University of Toronto, 1979 158 p 15 refs \$6 50

The conversion of national economies from those based on fossil fuels to those based on renewable or unlimited sources of energy is examined, with emphasis given to the position of Canada. The predicted demand for energy, which defines the future requirements to be met, is outlined, and the technical feasibility, environmental protection requirements, economic viability, domestic Canadian resources and necessary research and development activities are assessed for fossil fuels, nuclear fission, nuclear fusion, geothermal energy, solar energy, biomass energy, hydropower, wind energy and tidal power. Consideration is given to electrical power transmission systems and the depletion dates for fossil fuels and the lead times necessary to bring new energy sources on line are discussed, along with specific recommendations. The roles and interrelationships of government, industry and universities in Canada's pluralistic energy system are described and improved coordination is recommended. A L W

**A79-47072 European technology for obtaining energy from solid waste.** Edited by D J De Renzo. Park Ridge, N J, Noyes Data Corp (Energy Technology Review, No 34, Pollution Technology Review, No 54), 1978 299 p \$39

Western Europe is definitely the leader in the field of energy recovery from the combustion of municipal solid waste. For each country a national overview is given, followed by a description of particularly significant developments and case histories: household sorting and collection methods, combustors, furnaces, incinerators, air pollution control, latest plant designs, operation and economics. The case studies concern Toulouse-Le Mirail, France, Geneva-Cheneviers, Switzerland, Korsor, Denmark, Munich, Germany, and Brive, France. A summary of key findings is included along with maps and a tabulation of the European systems. S D

**A79-47198 Solar irradiance measurements by means of optical fibers and silicon detectors.** A Corrons and A Pons (Consejo Superior de Investigaciones Cientificas, Instituto de Optica, Madrid, Spain) *Applied Optics*, vol 18, Aug 15, 1979, p 2902-2904 11 refs

An experimental system has been constructed for the continuous measurement of solar irradiance using silicon diode detectors not directly exposed to solar radiation. The received incident solar radiation is conducted from the roof of the building to the detectors by an optical fiber. An electronic computer receives the signal and processes it, introducing the necessary corrections to calculate the total solar irradiance in W sq/m. The system measures with a proved accuracy to better than 3%. (Author)

**A79-47255 Advances in heat transfer Volume 14** Edited by T F Irvine, Jr (New York, State University, Stony Brook, N Y) and J P Hartnett (Illinois, University, Chicago, Ill.) New York, Academic Press, Inc., 1978 375 p \$34 50

These articles review recent advances in the theoretical and experimental study of heat transfer in various fields. Studies of heat transfer in geothermal systems are discussed, along with the literature on electrohydrodynamically (EHD) coupled heat transfer in liquids. Other topics include heat transfer between a gas fluidized bed and immersed boiler tubes, the effect of radiative transfer on certain types of motion in planetary atmospheres, and homogeneous nucleation in single-component vapors. F G M

**A79-47256 Heat transfer in geothermal systems.** P Cheng (Hawaii, University, Honolulu, Hawaii). In *Advances in heat transfer* Volume 14. New York, Academic Press, Inc., 1978, p 1-105 202 refs Research supported by Stanford University, NSF Grants No AER-72-03490-A04, No ENG-77-272527, Contract No E(04-3) 1093

Theoretical and experimental investigations of convective heat transfer in geothermal systems are reviewed. The governing equations for such heat transfer in geothermal systems are examined, along with heat transfer in hot-water, water steam two-phase, and geopressured geothermal systems. Lumped-parameter analyses for predicting averaged reservoir characteristics during production are considered, heat transfer in other geothermal systems (e.g., dry hot rock and magma) is briefly discussed, and investigations of heat transfer in geothermal wellbores are summarized. It is concluded that studies based on the idealization of a geothermal reservoir as a saturation porous medium can provide considerable insight into the physical processes involved. F G M

**A79-47260** Space technology spinoffs. G Gurney (U.S. Department of Defense, Washington, D.C.) New York, Franklin Watts, Inc., 1979 94 p 10 refs \$5.90

This popular work discusses the benefits derived from the NASA space program in areas including medicine, environmental protection, energy conservation and transportation. It examines the ability of space technology to meet the needs of society and its transfer into everyday life. Various contemporary and future space missions, including Landsat, Nimbus and GEOS are examined with reference to future possibilities of technology transfer. C F.W

**A79-47360 \*** Energy budget of the volcano Stromboli, Italy. T R McGetchin (Lunar and Planetary Institute, Houston, Tex.) and B A Chouet (MIT, Cambridge, Mass.) *Geophysical Research Letters*, vol 6, Apr 1979, p 317-320 24 refs Contract No NSR-09-051-001

The results of the analyses of movies of eruptions at Stromboli, Italy, and other available data are used to discuss the question of its energy partitioning among various energy transport mechanisms. Energy is transported to the surface from active volcanoes in at least eight modes, viz conduction (and convection) of the heat through the surface, radiative heat transfer from the vent, acoustical radiation in blast and jet noise, seismic radiation, thermal energy of ejected particles, kinetic energy of ejected particles, thermal energy of ejected gas, and kinetic energy of ejected gas. Estimated values of energy flux from Stromboli by these eight mechanisms are tabulated. The energy budget of Stromboli in its normal mode of activity appears to be dominated by heat conduction (and convection) through the ground surface. Heat carried by eruption gases is the most important of the other energy transfer modes. Radiated heat from the open vent and heat carried by ejected lava particles also contribute to the total flux, while seismic energy accounts for about 0.5% of the total. All other modes are trivial by comparison. S D

**A79-47399** Ion heating in the LT-3 tokamak. E L Bydder, B S Liley (Waikato University, Hamilton, New Zealand), and A H Morton (Australian National University, Canberra, Australia) *Plasma Physics*, vol 21, Aug 1979, p 669-686 15 refs

Results are reported for measurements of the ion temperature in the LT-3 tokamak device obtained by using a calibrated neutral-particle analyzer. Properties of the LT-3 machine are discussed, along with the neutral-particle analyzer, the ion energy profiles measured, time evolution of the disruptive instability in LT-3, and the calculated signal levels. The results show that the disruptive instability provides strong turbulent heating of the plasma ions and that all of the ions are most likely heated to several hundred electron volts in LT-3. However, the (energy) confinement time of the hot-ion plasma is found to be short, typically 50 to 80 microsec, presumably due to heat conduction. F G M

**A79-47419** Realistic Vlasov slab equilibria with magnetic shear. H E Mynick, W M Sharp, and A N Kaufman (California University, Berkeley, Calif.) *Physics of Fluids*, vol 22, Aug 1979, p 1478-1484 13 refs. Research supported by the U.S. Department of Energy

A method is described for generating exact Vlasov slab equilibria to model high-beta plasmas with strong magnetic shear. Physically reasonable distribution functions that account for such effects as end losses and density gradients are constructed from constants of the motion and used to calculate the self-consistent electrostatic and magnetic fields. As an application, numerically calculated equilibria modeling a torus sheath are presented. (Author)

**A79-47421** High-frequency convective loss-cone instability in short mirror machines. M J Gerver (Cornell University, Ithaca, N.Y.) *Physics of Fluids*, vol 22, Aug 1979, p 1510-1516 10 refs Contract No EY-76-S-02-3170-1

The high-frequency convective loss-cone mode is found to be absolutely unstable, due to (exponentially small) reflection of waves at the mirror throats, the critical length for stability is only a few ion Larmor radii. For Beta much greater than  $m$  sub  $e/m$  sub  $i$ , the following methods are shown not to substantially increase the critical length: (1) gradual tapering of the mirror throats (to reduce reflection), (2) partial filling of the loss cone with small amounts of warm plasma, (3) considering only low  $k$  perpendicular modes (since high  $k$ -perpendicular modes may saturate at a low level). This result places serious limitations on the design of mirror fusion reactors. (Author)

**A79-47422** Stability of tokamaks with elongated cross section. C H An (Tennessee University, Knoxville, Tenn.) and G Bateman (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Physics of Fluids*, vol 22, Aug 1979, p 1517-1526 37 refs Contracts No EY-76-S-052598, No W-7405-eng-26

Fixed boundary  $n = 1$  magnetohydrodynamic instabilities are studied computationally as a function of diamagnetism Beta sub  $p$  and current profile in elongated toroidal equilibria ( $1$  is less than  $b/a$  is less than or equal to  $4$ ). It is found that even slightly diamagnetic plasmas with a broad current profile and a highly elongated cross section are subject to a ballooning instability for  $q$  values well above unity at the magnetic axis. A peaked current profile in a mildly diamagnetic plasma decreases the elongation of the inner flux surfaces and reduces the marginal  $q$  value by suppressing ballooning modes. The maximum stable volume-averaged beta is achieved with a broad current profile and either a paramagnetic plasma (Beta sub  $p$  is less than  $1$ ) with a highly elongated cross section ( $b/a$  is greater than  $2$ ) or a diamagnetic plasma (Beta sub  $p$  is greater than  $1$ ) with only a mildly elongated cross section ( $b/a$  is less than  $2$ ). (Author)

**A79-47424** Two-dimensional self-modulation of lower hybrid waves in inhomogeneous plasmas. G P Leclert (MIT, Cambridge, Mass., Nancy, Université, Nancy, France), C F F Karney, A Bers (MIT, Cambridge, Mass.), and D J Kaup (MIT, Cambridge, Mass., Clarkson College of Technology, Potsdam, N.Y.) *Physics of Fluids*, vol 22, Aug 1979, p 1545-1553 19 refs NSF Grants No ENG-75-06242, No MPS-75-07568, Contracts No EX 76-01-22959, No N00014-76-C 0867

For lower hybrid waves in an inhomogeneous plasma, the two-dimensional self-modulation effects due to ponderomotive force are studied under the assumption that the field is electrostatic and has a narrow  $k$  spectrum. For a locally linear temperature profile and a broad class of density profiles, exact nonlinear solutions (solitons) are obtained by the inverse scattering method. The solitons decay and spread as they propagate. In addition to the usual area condition on the potential integral of  $\phi$  d  $x$  is greater than or equal to  $\pi/2$ . Inhomogeneity introduces a second condition for solitons to occur. It is shown that this second condition is not satisfied in typical tokamak plasmas, i.e., there is no soliton formation, in contrast to the homogeneous case. Furthermore, the scaling of the threshold conditions with density and temperature makes them more difficult to satisfy in larger machines. (Author)



**A79-47426** Effects of turbulent heating in the Texas turbulent torus K W Gentle, R Bengtson, J Jancarik, T Kochanski, D Patterson, P Phillips, and R Stinnett (Texas, University, Austin, Tex.) *Physics of Fluids*, vol 22, Aug 1979, p 1558-1569 17 refs Research supported by the U.S. Department of Energy and Texas Atomic Energy Research Foundation

Turbulent heating of a 10 cm radius plasma in a tokamak configuration with densities up to  $10^{13}$  per cu cm produces a strong skin effect. Although the applied electric field at the outside of the column reaches 100 V/cm and the electron drift velocity exceeds the thermal velocity, penetration is slight at these densities during the microsec pulse. The energy dissipated in the skin during the pulse can reach 5 mJ/cu cm, the equivalent of 30 keV per electron there, but losses associated with the turbulence are substantial. Average electron energies from the heating larger than 2 keV in the skin and 500 eV overall have not been found. (Author)

**A79-47427** Effect of scrape-off on tokamak radial transport A El Nadi (Cairo University, Giza, Egypt) *Physics of Fluids*, vol 22, Aug 1979, p 1570-1573 11 refs

A general procedure is presented to evaluate the tokamak particle and energy losses in the presence of a poloidal divertor or a toroidal limiter, assuming cold collisional electrons and hot collisionless ions in the scrape-off layer. The case of the limiter is treated in detail and approximate expressions for the losses, to be incorporated in the tokamak transport equations, are obtained. The importance of the barely trapped particles in determining the radial profiles is emphasized. (Author)

**A79-47452** A fast-scanning heterodyne receiver for measurement of the electron cyclotron emission from high-temperature plasmas P C Efthimion, V Arunasaian, R Bitzer, L Campbell, and J C Hosea (Princeton University, Princeton, NJ) *Review of Scientific Instruments*, vol 50, Aug 1979, p 949-951 10 refs Contract No EY-76-C-02-3073

A fast-scanning heterodyne receiver into a plasma diagnostic that measures the fundamental cyclotron emission from the PLT plasma and thus ascertains the time evolution of the electron temperature profile was developed. The receiver scans 60-90 GHz every 10 ms and is interfaced to a computer for completely automated calibrated temperature measurements. (Author)

**A79-47490 #** Photoelectric characteristics of silicon insulator/semiconductor structures with induced channels (Fotoelektricheskie kharakteristiki kremnievykh struktur dielektrikopoluprovodnik s indutsirovannym kanalom). B I Gil'man, A P Gorban', M B Zaks, V G Litovchenko, V V Kasatkin, A A Serba, and Iu V Skokov (Akademiia Nauk Ukrainsoi SSR, Institut Poluprovodnikov, Kiev, Ukrainian SSR) *Poluprovodnikovaia Tekhnika i Mikroelektronika*, no 29, 1979, p 19-24 14 refs In Russian

An experimental study of the characteristics of silicon insulator/semiconductor structures with induced channels is presented. Consideration is given to (1) the photo-I-V characteristics, (2) dependence of short-circuit current on illumination, (3) the spectral characteristics, and (4) local photosensitivity. The development of solar cells on the basis of these structures is considered. B J

**A79-47506** Isotopic anomalies of rare gases in the Nigorikawa geothermal area, Hokkaido, Japan. K Nagao, N Takaoka (Osaka University, Toyonaka, Japan), and O Matsubayashi (Geological Survey of Japan, Kawasaki, Japan) *Earth and Planetary Science Letters*, vol 44, no 1, July 1979, p 82-90 14 refs

Anomalous isotopic compositions of rare gases were determined for gas samples enriched in  $\text{CO}_2$  collected in the Nigorikawa geothermal area, Hokkaido, Japan. A high isotopic ratio of  $3\text{He}/4\text{He} = (9.95 \pm 0.25) \times 10^{-6}$  to the minus 6th power was obtained for a sample collected from bubbles seeping out of a cold water pond in an abandoned sulfur mine. The sample had a rare gas

elemental abundance pattern attributable to low-temperature solubility of atmospheric rare gases in water, and soil gas samples indicate mass fractionation of atmospheric rare gases, in addition to the originally high  $3\text{He}/4\text{He}$  ratio. The highest  $20\text{Ne}/22\text{Ne}$  ratio was associated with the highest  $36\text{Ar}/38\text{Ar}$  ratio, and a systematic enrichment of the light isotopes of Kr and Xe. The enrichment of the light isotopes in gas and soil gas samples was accompanied by a systematic enrichment of the light gases, and migration of rare gas in the crust is responsible for this isotopic and elemental fractionation. A T

**A79-47573** Deposition of the conduction-enhancing alkali metal from a fog in closed-cycle MHD generator systems. K M Aref'ev, V M Borishanskii, N I Ivashchenko, and N M Fishman *Heat Transfer - Soviet Research*, vol 10, Nov-Dec 1978, p 132-140 6 refs Translation

A technique for calculating heat and mass transfer in the condensation of an alkali-metal additive in the form of a fog has been developed. Experimental data on the deposition of cesium vapor from argon under conditions close to those prevailing in condensing heat exchangers of closed-cycle MHD units are presented. It is shown that fog formation greatly reduces the deposition of the metal from the gas onto cold surfaces of the condensing heat exchanger. (Author)

**A79-47591** Activation and desorption properties of iron particle catalysts for the Fischer-Tropsch synthesis (Aktivierung und Adsorptionsverhalten von Eisenfällungskatalysatoren für die Fischer-Tropsch-Synthese). J Kneer, W Bradler, and M Ralek (Berlin, Technische Universität, Berlin, West Germany) *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol 32, July 1979, p 323-325 22 refs In German

The chemisorption of CO on promoted catalysts was investigated with regard to the pretreatment by a temperature programmed desorption (TPD) technique. Two different states were indicated where the kind of pretreatment affects the BET surface, the amount of adsorbed gas, and the capacity of the two chemisorption states. It was found that catalysts treated with CO alone had a higher coverage of chemisorption while those treated with both CO and H displayed opposite behavior. Results showed that activation energies of desorption differ by approximately 6 kJ/mol regardless of the degree of alkanization at selected capacities and that the adsorption capacity shows an evident increase for H treated catalysts depending on the alkanization which is duplicated with additional CO treatment. C F W

**A79-47602** Theta-pinch description from classical electrodynamics. E A Witalis (Forsvarets Forskningsanstalt, Stockholm, Sweden) *International Journal of Fusion Energy*, vol 2, Winter 1979, p 67-87 32 refs

The large and extensively reported discrepancies between theoretically expected and experimentally observed theta-pinch properties are briefly reviewed. The denial in basic MHD theory of the observed strong plasma mass rotation can be traced back to a too simplified and restrictive plasma single-fluid formulation. Adopting a two-fluid description, a basic equation for ion motion is rewritten so as to express, in a moving frame, conservation of ionic canonical angular momentum. The electronic charge transport in fluid and particle formulations is discussed and expressed quite generally as a magnetization current. The combined ion and electron charge equations yield upon integration a linear differential equation for which the presented solutions relate the magnetic flux within the plasma to the plasma column expansion or compression. Special attention is given to solutions that describe much discussed observations like the separation of the imploding plasma density gradient ahead of or behind the magnetic field gradient, or an azimuthal ion velocity reversal. The 'magnetic piston' concept is criticized. Power and energy considerations from classical electromagnetic theory of magnetized media and linear current systems explain the remarkable influence of initial bias field upon the implosion dynamics. (Author)

**A79-47651 \* #** A mobile apparatus for solar collector testing. G B Hotchkiss (Texas Instruments, Inc., Dallas, Tex.), F F Simon (NASA, Lewis Research Center, Cleveland, Ohio), and L C Burmeister (Kansas University, Lawrence, Kan.) *American Society of Mechanical Engineers, Design Engineering Conference and Show, Chicago, Ill., May 7-10, 1979, Paper 79-DE-5* 6 p 14 refs Grant No N5G-3087

The design, construction, and operation of a mobile apparatus for solar collector testing (MASCOT) is described. The MASCOT is a self-contained test unit costing about \$10,000 whose only external requirement for operation is electrical power and which is capable of testing two water-cooled flat-plate solar collectors simultaneously. The MASCOT is small enough and light enough to be transported to any geographical site for outdoor tests at the location of collector usage. It has been used in both indoor solar simulator tests and outdoor tests. (Author)

**A79-47652 #** Computer simulation and design of the control system for a wind turbine generator. H Sambar, V Pavelic, and R J Warner (Wisconsin University, Milwaukee, Wis.) *American Society of Mechanical Engineers, Design Engineering Conference and Show, Chicago, Ill., May 7-10, 1979, Paper 79-DE-9* 5 p 8 refs

The wind turbine generator proposed is a horizontal axis machine with three blades operating downwind. A hydraulic system actuates mechanical linkages to control blade pitch during operation. The blade pitch control concept provides active control of rotor rpm above the rated wind speed and during no load condition. The lowering of blade and tower loads while providing the capability for well tuned rotor control are its primary features. A hydraulic system, designed to control the pitch of the blades of a wind turbine generator, is simulated on the digital computer using the Runge-Kutta method. The control system subroutine is coupled with the aerodynamic subroutines of the blades to represent the model for the wind turbine generator. The response of the simulated wind turbine to a real wind case is shown to agree with the desired response. (Author)

**A79-47700 #** The optimization of efficiency relationships of the reverse hydraulic equipment of a hydraulic accumulator power station (K voprosu ob optimizatsii sootnosheniia k.p.d. obratnykh gidroagregatov gidroakkumuliruiushchikh elektrostantsii). V A Shapovalova (Leningradskii Politekhicheskii Institut, Leningrad, USSR) *Energetika*, vol 22, Apr 1979, p 87-90 6 refs In Russian

The optimum relationship between the efficiencies of the pump and turbine regimes of hydraulic accumulator hydroelectric station operation is investigated. Factorial design is employed to analyze the relative influences of the efficiencies of the turbine and pump regimes and the power produced and required. It is found that the effectiveness of a hydraulic accumulator power station depends on the relationship between turbine and pump efficiencies and the capital investments in the equipment, the extent of the influence of the turbine/pump relationship depending on the capital investment. A L W.

**A79-47790** Ni cermet selective absorbers for solar photo-thermal conversion. M Okuyama, K Furusawa, and Y Hamakawa (Osaka University, Toyonaka, Japan) *Solar Energy*, vol 22, no 6, 1979, p 479-482 23 refs

Optical properties of Ni cermet thin film have been investigated for a selective absorber of photothermal conversion devices. Fabrication technology is presented for cermet with fine particles of Ni embedded in SiO<sub>2</sub> or MgO(SiO<sub>2</sub>/Ni, MgO/Ni). Optimum design calculations for these surfaces have been made and discussed with the experimental results. Fabricated multilayer films consisting of SiO<sub>2</sub>-Ni cermet-Ni exhibit good photothermal conversion efficiency and thermal stability at high temperature up to 773K. (Author)

**A79-47791** Thermodynamic basis for the choice of working fluids for solar absorption cooling systems. G Ali Mansoori and V Patel (Illinois University, Chicago, Ill.) *Solar Energy*, vol 22, no 6, 1979, p 483-491 11 refs. NSF Grant No GK-43139

Through the application of the first and second laws of thermodynamics upper and lower limits for the coefficient of performance (COP) of absorption cooling cycles are derived. These upper and lower limits, besides being dependent on the environmental temperatures of components of the cycle, are also dependent on the thermodynamic properties of refrigerants, absorbents, and their mixtures. With the use of these upper and lower limits of COP it is now possible to make a quantitative comparative study of different refrigerant-absorbent combinations. The technique developed is applied for the comparative evaluation of NH<sub>3</sub>+H<sub>2</sub>O, NH<sub>3</sub>+NaSCN and H<sub>2</sub>O+LiBr combinations which are the favorable candidates used in solar absorption cooling cycles. (Author)

**A79-47792** An analysis of the terminal concentrator concept for solar central receiver systems. K Athavaley, F Lipps, and L Vant-Hull (Houston University, Houston, Tex.) *Solar Energy*, vol 22, no 6, 1979, p 493-504 5 refs NSF Grant No GI-39456, Contract No EG-77-C 04-3974

The central receiver system concept, a large scale solar energy development for electrical power production, is presented. This system employs a large number of individual guided heliostats that reflect the sunlight towards a central receiver high above the heliostat field. In the case where high concentration is needed a terminal concentrator used to increase the concentration of solar flux reflected from the collector field is attached. It was found, however, that to provide for maximum concentration, the terminal concentrator becomes excessively large and consequently a different design was developed that produces 90% concentration and reduces the size of the conical reflector by 5 or 6 times. Results show that this design of a practical terminal concentrator of canonical variety will nearly double the concentration without losing any total power. C F W.

**A79-47794** Thermal analysis in the focal spot of a solar furnace. E Lorenzini and M Spiga (Bologna University, Bologna, Italy) *Solar Energy*, vol 22, no 6, 1979, p 515-520 9 refs

**A79-47795** Relation between concentration and acceptance in solar collectors. F Grasso, F Musumeci, and A Triglia (Catania University, Catania, Italy) *Solar Energy*, vol 22, no 6, 1979, p 521-525 7 refs

The maximum concentration ratio has been derived by Winston for optical systems having an angular acceptance described by a step function. In this paper a more comprehensive relation between maximum concentration ratio and angular acceptance is obtained. This relation is valid for any acceptance function, the proof is based on thermodynamics and is valid for large angles as well. The total energies collected yearly by concentrators having different acceptance functions are compared. (Author)

**A79-47796** Thermal properties of the Florida Current as related to ocean thermal energy conversion (OTEC). P A Mangarella and W E Heronemus (Woodward-Clyde Consultants, San Francisco, Calif.) *Solar Energy*, vol 22, no 6, 1979, p 527-533 20 refs NSF Grant No GI 34979

The thermal properties of the Florida Current are presented and analyzed for the available ocean thermal energy. For a cold water intake depth equal to or greater than 600 m, potential sites for ocean thermal energy conversion (OTEC) power plants appear to exist in the Straits of Florida and, to a lesser extent, off the coasts of Georgia and South Carolina. The maximum thermal differences occur on the continental shelf because of the geostrophic motion of the Gulf Stream. An estimate of the total available ocean thermal energy from the Florida Current, delivered in the form of electricity, is 3.5 x 10 to the 12th kWh/yr. For a cold water suction depth of 600 m or more, seasonal variability in the ocean thermal resource is approx + or - 35 per cent of average annual output. (Author)

**A79-47797** An evacuated glass tube solar collector and its application to a solar cooling, heating and hot water supply system for the hospital in Kinki University. K Hinotani, K Kanatani, and

M. Osumi (Sanyo Electric Co., Ltd., Hirakata, Osaka, Japan). *Solar Energy*, vol. 22, no. 6, 1979, p. 535-545. 5 refs.

**A79-47798**      **New technologies for solar energy silicon - Cost analysis of UCC Silane process.** C. L. Yaws, F. C. Jelen, K.-Y. Li, P. M. Patel (Lamar University, Beaumont, Tex.), and C. S. Fang (Southwestern Louisiana University, Lafayette, La.). *Solar Energy*, vol. 22, no. 6, 1979, p. 547-553. 49 refs. Research sponsored by the U.S. Department of Energy.

A preliminary process design was performed to provide detailed data for cost analysis. The design was based on a plant size of 1000 metric tons/yr production of solar cell grade silicon. Cost and sensitivity analysis results are presented for producing silicon which includes costs for raw materials, labor, utilities, and other items composing product cost. For sensitivity analysis, the order of cost parameter influence on product cost is given by plant investment, raw materials, labor, and utilities. A cost and profitability analysis summary is also presented including sales price of polysilicon at various rates of return on investment. V.T.

**A79-47799**      **Cover systems for high temperature flat-plate solar collectors.** R. Gani and J. G. Symons (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Highett, Victoria, Australia). *Solar Energy*, vol. 22, no. 6, 1979, p. 555-561. 11 refs.

A simulation study has been conducted of the influence of cover design on the thermal performance of flat-plate solar collectors for use at temperatures of 150 C. Detailed results are presented of the effects of changes in cover materials, cover surface treatments, cover system configuration and absorber plate surface treatments on both the instantaneous efficiency and the long term solar contribution of flat-plate collectors. For the simulation conditions, it is shown that flat-plate collectors consisting of a single high transmittance cover, a convection suppressing device such as a honeycomb and a selective absorber surface yield long term solar contributions comparable to those of evacuated tubular collectors, whereas other configurations simulated (single and multiple cover systems) are significantly inferior. (Author)

**A79-47800**      **Analysis of an evacuated cylindrical solar collector.** J. D. Felske (New York, State University, Amherst, N. Y.). *Solar Energy*, vol. 22, no. 6, 1979, p. 567-570. 9 refs. NSF Grant No. PTP-75-05156.

Equations for computing the transmission of beam radiation through a cylindrical glass envelope and onto an enclosed flat absorbing plate are developed for an evacuated solar collector. The study applies to the general case where the plate and cylinder are arbitrarily oriented and receive beam radiation from any arbitrary direction. The resulting cylinder transmittances for all possible orientations are compared with the corresponding flat-plate transmittances. It is shown that depending upon the conditions, the cylinder may have either a greater or a lesser transmittance than the flat plate. V.T.

**A79-47802**      **Fabrication and characterization of SnO<sub>2</sub>/n-Si solar cells.** T. Nagatomo, M. Endo, and O. Omoto (Shibaura Institute of Technology, Tokyo, Japan). *Japanese Journal of Applied Physics*, vol. 18, June 1979, p. 1103-1109. 17 refs.

SnO<sub>2</sub>/n-Si solar cells fabricated by the spray pyrolysis technique display significant photovoltaic effects when exposed to sunlight. These solar cells have a thin insulating layer at the SnO<sub>2</sub>/n-Si interface. The presence of the thin insulating layer can increase the open-circuit voltage by increasing the diode quality factor and by reducing the dark saturation current. The performance of this heterojunction solar cell was an open-circuit voltage of 0.52 V, short-circuit current of 210 mA/sq cm, fill factor of 0.53 and

conversion efficiency of 7.2%. The relative photospectral response above fifty percent spreads in a range of 420 to 1020 nm and is wider than that of conventional Si p-n solar cells. One possibility for cost reduction lies in the method of junction fabrication, and the idea of a simply deposited SnO<sub>2</sub>/n-Si junction is very attractive. (Author)

**A79-47804**      **Analytical approximations in the theory of relativistic Thomson scattering for high temperature fusion plasma.** T. Matoba, T. Itagaki, T. Yamauchi, and A. Funahashi (Japan Atomic Energy Research Institute, Tokai, Japan). *Japanese Journal of Applied Physics*, vol. 18, June 1979, p. 1127-1133. 5 refs.

The light scattering spectrum from a high temperature plasma is calculated for the second order in  $v/c$  ( $c$  = light speed) and the second order approximate formula is obtained from the calculation. The blue side shift of the peak derived from the second order approximate formula agrees well with that of the full relativistic spectrum for an electron temperature of several tens of keV and less. The second order apparent temperature and density are deduced with an accuracy of better than 8% in the range up to 20 keV and 100 keV for scattering angles of 90 and 50 deg, respectively, by application of the least-square procedure. (Author)

**A79-47805**      **Characteristics of co-axial Marx generator and its application to electron beam fusion.** K. Takagi, Y. Kubota, and A. Miyahara (Nagoya University, Nagoya, Japan). *Japanese Journal of Applied Physics*, vol. 18, June 1979, p. 1135-1141. 7 refs.

A co-axial Marx generator with a short rise time of pulse less than 4 nsec, and approximately 40 nsec flat top duration was successfully constructed. For the attainment of electron beam fusion, the requirements for the beam source are a rise time of less than 1 nsec, an impedance of less than 0.01 ohm and an inductance of less than several nH/MV. The co-axial Marx generator can be considered to be the most important tool for these purposes. The rectangular output pulse of the co-axial Marx generator was analyzed and applied to electron beam fusion. (Author)

**A79-47806**      **A method for measuring the photothermal conversion efficiency of solar energy.** T. Tanaka (Sony Corp., Research Center, Yokohama, Japan). *Japanese Journal of Applied Physics*, vol. 18, June 1979, p. 1153-1155.

An instrument and a method for measuring the photothermal conversion efficiency of solar energy, based on a temperature equilibrium-type radiometer, are described. The efficiency of certain transition metal oxides is measured at room temperature using samples 0.7 mm in thickness. Magnetite and cupric oxide have efficiencies of 0.93 and 0.96, respectively. (Author)

**A79-47807**      **Production of repetitive dense plasmas in a focus device with inductive energy storage.** I. Ueno (Tokyo, University, Tokyo, Japan), J. Salge, B. Fell, U. Braunsberger (Braunschweig, Technische Universität, Braunschweig, West Germany), and H. Conrads (EURATOM and Kernforschungsanlage Jülich GmbH, Institut für Plasmaphysik, Jülich, West Germany). *Japanese Journal of Applied Physics*, vol. 18, June 1979, p. 1189, 1190. 5 refs. Research sponsored by the Deutsche Forschungsgemeinschaft and Alexander von Humboldt-Stiftung.

A plasma focus device with inductive energy storage is described, and evidence is presented for a mode of the plasma-focalization sequence different from the mode reported by Salge et al. (1978). Characteristics of the plasma-focus repetition are examined for the case where the focus is supplied with a long-lasting current pulse from inductive energy storage. Experiments are discussed which show that the focus discharges are self-triggered at the breech end of the accelerator and that neutron bursts are observed for every subsequent pinch at the top of the accelerator. F.G.M.

**A79-47812** Market penetration characteristics for energy production and atmospheric carbon dioxide growth. J. A. Laurmann (Stanford University, Stanford, Calif.) *Science*, vol 205, Aug 31, 1979, p 896-898 8 refs

Estimates are given for the maximum rate at which fossil fuel consumption can be reduced by the introduction of noncarbon-based energy sources, according to the market penetration time concept. These estimates indicate an immediate need to implement a revised energy policy if major climatic changes induced by increased amounts of carbon dioxide are to be avoided in the next century. However, application of market penetration ideas to energy consumption is new and may not be valid for the prediction of future trends (Author)

**A79-47813** Dehydration of ethanol - New approach gives positive energy balance M. R. Ladisch and K. Dyck (Purdue University, West Lafayette, Indiana) *Science*, vol 205, Aug 31, 1979, p 898-900 26 refs

A method of dehydrating ethanol in which the combustion energy of the ethanol product exceeds the energy needed to carry out the dehydration by a factor of 10 is presented. This involves removing water from aqueous ethanol by using cellulosic materials, starch, corn, and other agents. Column temperature was found to have a significant effect on dehydration at T equal to 91 C, corn easily dehydrates alcohol and at 79.5 C this capacity is diminished. The advantage of using organic rather than inorganic dehydration agents is that the temperature of regeneration is lower for starch or celluloses (60 to 110 C) than for CaO (160 to 170 C), thus utilizing lower temperature energy for regenerating a dehydrating agent such as cellulose or starch C F W

**A79-47882** # Manned strategic system concepts 1990-2000. C. D. Wiler and D. P. Raymer (Rockwell International Corp., North American Aircraft Group, Los Angeles, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1793* 15 p. Contract No. F33615-77-C-0115

Manned strategic system concept designs are discussed, requiring the development of new technologies in the areas of aerodynamics, propulsion, structures, controls, and stealth. A total of 34 innovative concepts were prepared using the advanced technologies. Concepts were designed to a strategic 'high-low-low-high' missions, with several exceptions, and can be grouped into four major categories: (1) low-cost simplistic, (2) minimum weight, (3) supersonic penetration, (4) laser defended. The concepts were qualitatively rated to select the best two or three concepts in each category. These remaining candidate concepts were then subjected to a preliminary sizing exercise to select one baseline per category. The baselines were sized, configured, analyzed, and reconfigured V T

**A79-47906** # All electric subsystems for next generation transport aircraft. J. W. Phillips (Lockheed Georgia Co., Flight Sciences Div., Marietta, Ga.) and N. E. Wood (AirResearch Manufacturing Company of California, Torrance, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1832* 12 p.

A technology assessment study conducted to evaluate the applicability of an all-electric airplane concept to transport aircraft is presented. The study compared two all-electric variations of the Lockheed medium advanced transport aircraft (ATA) with the existing ATA that utilizes advanced structures, aerodynamics, and engines, but conventional secondary power systems. The results of reconfiguration tradeoff studies conducted on the primary and secondary flight controls, engine start, environmental control, secondary power generation and distribution, and the landing-gear brakes are considered. Maintainability, reliability, and weight analyses are outlined V T

**A79-47918** \* # Energy efficient aircraft engines. R. Chamberlin and B. Miller (NASA, Lewis Research Center, Energy Conservative Engines Office, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1861* 11 p.

The three engine programs that constitute the propulsion portion of NASA's Aircraft Energy Efficiency Program are described, their status indicated, and anticipated improvements in SFC discussed. The three engine programs are: (1) engine component improvement, directed at current engines, (2) energy efficient engine, directed at new turbofan engines, and (3) advanced turboprops, directed at technology for advanced turboprop-powered aircraft with cruise speeds to Mach 0.8. Unique propulsion system interactive ties to the airframe resulting from engine design features to reduce fuel consumption are discussed. Emphasis is placed on the advanced turboprop since it offers the largest potential fuel savings of the three propulsion programs and also has the strongest interactive ties to the airframe (Author)

**A79-47919** # Air buoyant vehicles - Energy efficient aircraft V. H. Pavlecka (Airships International, Inc., Tustin, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1862* 7 p.

Energy and overall economic considerations of airplane and two airships in terms of a cost intensity parameter indicate that Metalclad airships can now be constructed and operated with an economic superiority to wide-body jet transports. Comparisons are based on computer printouts of actual flights of 747F and on design studies of MC 80 and MC-100 B J

**A79-47920** # Laminar flow stabilization by surface cooling on hydrogen fueled aircraft. J. G. Theisen (Lockheed-Georgia Co., Marietta, Ga.), G. D. Brewer, and L. R. Miranda (Lockheed California Co., Burbank, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1863* 12 p. 30 refs. Research supported by Lockheed-California Independent Research and Development Funds.

The feasibility of delaying the transition from laminar to turbulent flow over aerodynamic surfaces by cooling those surfaces, to decrease friction and increase fuel economy of aircraft, is discussed. For the 'energy crisis', hydrogen is being considered as an alternate fuel, so its cryogenic properties may be used for cooling below the 280 deg R known to stabilize boundary layers. Equations for the stability analysis of a two-dimensional, compressible, laminar boundary layer are presented, including heat transfer and adverse pressure gradient effects which constitute the principal new technological contribution of this study, for near-cruise flight. Preliminary systems analysis for an advanced commercial transport shows drag reductions near 27% and lower direct operating costs (DOC) by over 21% (Author)

**A79-47944** Toward optimal control of solar energy systems S. F. McCormick (Colorado State University, Fort Collins, Colo.) In: 1978 Conference on Decision and Control, 17th, San Diego, Calif., January 10-12, 1979, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 193-196 5 refs.

The paper focuses on a project designed to investigate the feasibility of a microprocessor-based control device for use in domestic solar energy systems. The underlying objective is to emphasize that fundamental simplicity both in design and implementation is a key to reducing the software difficulties and succeeding in the development of effective devices for process control. The development goals of the controller considered include cost effectiveness, stability, flexibility, adaptability and weather predictability. Although these characteristics are achieved at the expense of additional system hardware requirements, the balance appears to be well in favor of the controller system discussed S D

**A79-48376 # Hydrocarbons in ambient air I - A statistical estimation of automobile hydrocarbons by factor analysis.** Y Tsujino (Environment Pollution Control Center, Osaka, Japan) *Japan Society of Air Pollution, Journal*, vol 14, no 5, 1979, p 179-189 12 refs In Japanese, with abstract in English

Statistical estimates of automobile hydrocarbon emission were made on the basis of results reported in a road/tunnel survey. Several common factors conditioning emissions were obtained, including vehicle traveling conditions, speed, type of fuel, number of engine cycles, and two background factors. Techniques for estimating the relative contributions of different types of emission sources are presented. B J

**A79-48511 Study of heat-pipe heat exchanger in the small gas turbine engine system.** V K Shchukin, I I Mosin, N V Lokai, and Iu V Matveev (*Aviatsionnaia Tekhnika*, vol 21, no 3, 1978, p 127-132) *Soviet Aeronautics*, vol 21, no 3, 1978, p 93-96. Translation

In the present paper, the structural elements of a heat exchanger employing heat pipes is theoretically optimized with a view toward using such exchangers as liquid coupled indirect-transfer regenerators for gas-turbine plants. A regeneration ratio of 0.82 at duct pressure losses of less than 6 percent is obtained. This theoretical value is verified by model experiments. V P

**A79-48632 Computer-Aided Power System Design.** J E O'Reilly, Jr (South Florida, University, Tampa, Fla) and H L Southall (USAF, Aerospace Power Div, Wright-Patterson AFB, Ohio) In *NAECON 1979, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 15-17, 1979. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p 504-508 10 refs. Contract No F33615-77-C-2059

This paper presents the Computer-Aided Power System Design (CAPSD) computer program. This program allows for the output-to-input design of high power systems interactively. CAPSD is basically an executive routine which ties together various high-power subprograms each of which performs a vital (or at least useful) analysis to perform a piece of a total high-power system design. The design program is written in ANSI FORTRAN IV and utilizes routines also written in FORTRAN IV. CAPSD can readily be adapted to process any high-power design program. The program is implemented on both the IBM 370/165 and CDC 6600 model machines. Initial testing of the program has generated enthusiasm in the executive approach of the software as an increase in the use of the power design routines due to the ease of data entry at the interactive level. (Author)

**A79-48654 A parameter sensitivity analysis of the rectified superconducting alternator model.** T A Stuart (Toledo, University, Toledo, Ohio) In *NAECON 1979, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 15-17, 1979. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p 713-718. Grants No AF-AFOSR-76-2997, No AF-AFOSR-77-3413

A sensitivity analysis of the steady state model of the rectified superconducting alternator is discussed. The analysis indicates how the model is affected by errors in the inductance values for the six mutually coupled circuits which represent the alternator. This is accomplished by conducting a large number of computer simulations, where the results for each variable are shown in graphical form. It is shown that the model is most sensitive to those self and mutual inductances associated with the armature windings. (Author)

**A79-48734 # Energy balance of solar thermoelectric generators (Energeticheskii balans solnechnogo termoelektrogeneratora).** V A Baum, Ch Agabaev, and N Obezskhatov (Akademiia Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Geliotekhnika*, no 3, 1979, p 3-6. In Russian

The paper develops a computational method for determining the maximum efficiency of a solar thermoelectric generator. It is shown that the efficiency of a solar thermoelectric system with natural cooling and without radiation concentration is less than 1%. B J

**A79-48735 # Large-area silicon photocells for the investigation of the optical/energetic characteristics of solar and radiant-energy concentrators (Mnogoploschchadachnye kremnievye foto-preobrazovateli dlia issledovaniia optiko-energeticheskikh kharakteristik kontsentratorov solnechnoi i luchistoi energii).** A Ia Gliberman, I I Kovalev, B I Krasilovskii, and L M Medvedeva (Vsesouzhnyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Kishinev, Moldavian SSR) *Geliotekhnika*, no 3, 1979, p 7-10 5 refs. In Russian

**A79-48737 # Thin-film and ceramic cadmium sulfide/cadmium selenide solar cells (Tonkoplennochnye i keramicheskie solnechnye preobrazovateli na osnove sul'fida i selenida kadmia).** V N Komashchenko, A I Marchenko, and G A Fedorus (Akademiia Nauk Ukrainsoi SSR, Institut Poluprovodnikov, Kiev, Ukrainian SSR) *Geliotekhnika*, no 3, 1979, p 15-21 12 refs. In Russian

**A79-48738 # Principles for the calculation of heliostat fields of a solar power plant (Printsipy rascheta geliostatnykh polei solnechnoi energeticheskoi stantsii).** R A Zakhidov (Akademiia Nauk Uzbeksoi SSR, Tsentral'noe Priobno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priobrostoeniia, Uzbek SSR) *Geliotekhnika*, no 3, 1979, p 22-27 13 refs. In Russian

The paper attempts to develop a general computational model for solar-tower concentrating systems. The model takes into account a number of factors, including the solar radiation characteristics, the arrangement of heliostats, the shape of mirrors, collector configurations, etc. Formulas are obtained for calculating insolation for collectors and heliostats of arbitrary configuration. B J

**A79-48739 # Heating characteristics of concentrator/receiver systems using selective absorption surfaces (Nagrevnye kharakteristiki sistemy kontsentrator-priemnik pri ispol'zovanii poverkhnosti selektivnogo luchepogloshcheniia).** O I Kudrin and A Abdurakhmanov *Geliotekhnika*, no 3, 1979, p 28-33 5 refs. In Russian

**A79-48826 # Determination of the design states of a complex system in evaluating the reliability of electrical power supply (Opredelenie raschetnykh sostoiianii slozhnoi sistemy pri otsenke nadezhnosti elektrosnabzheniia).** Iu A Fokin, C D Long, and G P N Vidzhaindu (Moskovskii Energeticheskii Institut, Moscow, USSR) *Energetika*, vol 22, May 1979, p 5-10. In Russian

A so-called structural approach is used to evaluate the reliability of a complex electrical energy supply system. The objectives of the study are (1) to make a preliminary selection of the subset of most probable design states from the set of all possible states, and (2) to identify in this subset that group of states which have the dominant effect on the formation of the system power deficit. This preliminary selection makes possible a considerable reduction in the computational procedure for determining system power deficit. B J

**A79-48827 # Effect of pressure head on the characteristics of hydroelectric stations with underwater lower reservoirs (Vliianie napora na pokazateli gidroakkumuliruiushchikh elektrostantsii s podzemnymi nizhnimi bassainami).** G A Pretro (Ukrainskii Institut Inzhenerov Vodnogo Khoziaistva, Revno, Ukrainian SSR) *Energetika*, vol 22, May 1979, p 80-86 8 refs. In Russian

**A79-48864 Erosion study of different materials affected by coal ash particles.** W Tabakoff, R Kotwal, and A Hamed (Cincinnati, University, Cincinnati, Ohio) *Wear*, vol 52, Jan 1979, p 161-173 8 refs. Contract No E(48-18)-2465

Alloys in contact with coal particles or coal ash are exposed to erosion. The problem of predicting erosion is very complex. The present paper describes the test facility which is designed in such a way that the aerodynamic effects are an integral part of the erosion test parameters. Some results from the alloys studied (aluminum, stainless steel and titanium) in this investigation are reported.

(Author)

**A79-48911** High-temperature alloys in high-technology systems. C T Sims (General Electric Co., Gas Turbine Div., Schenectady, NY) In High temperature alloys for gas turbines, Proceedings of the Conference, Liège, Belgium, September 25-27, 1978 Barking, Essex, England, Applied Science Publishers, Ltd., 1978, p 13-65 23 refs

The phase basis of austenitic superalloys is reviewed briefly, followed by comparison of their capabilities to all other alloy systems. Then, seven advanced high-technology systems including aircraft engines, coal derived fuel-fired energy plants, and future reactor systems are viewed, first as operating plants, then as technologies utilizing superalloys, with emphasis on the problems superalloys will face. Next, an attempt is made to collate the use pattern of superalloys in these systems into superalloy families, which then leads to discussion of the metallurgical features, with emphasis on microstructural behavior. Finally the major problems expected for the future are summarized.

(Author)

**A79-48912** The role of corrosion in modern gas turbines. P C Felix (Brown, Boveri & Cie AG, Baden, Switzerland) In High temperature alloys for gas turbines, Proceedings of the Conference, Liège, Belgium, September 25-27, 1978 Barking, Essex, England, Applied Science Publishers, Ltd., 1978, p. 69-79 5 refs.

It is shown that coatings for gas-turbine blades must meet the following requirements: corrosion resistance, erosion/impact resistance, physical integrity, thermal stability, mechanical strength, adhesion, and economy. Thus, new coatings should be optimized with a view toward each of these requirements, and not to a high corrosion resistance only. Making some tradeoffs seems unavoidable.

V P.

**A79-49037** Boundary layer velocity measurements in combustion MHD channels. S. A. Self (Stanford University, Stanford, Calif.). In Laser velocimetry and particle sizing, Proceedings of the Third International Workshop, West Lafayette, Ind., July 11-13, 1978. Washington, D.C., Hemisphere Publishing Corp., 1979, p 347-356. NSF Grant No. GK 04116, Contracts No F33615-72-C-1088, No EX-76-C-01-2341

The paper discusses velocity measurements by laser anemometry in the boundary layers of combustion MHD generator channel flows. Combustion MHD facility is described along with laser anemometry requirements and problems. The design and capabilities of two laser anemometer systems are presented: a single beam backscatter system, and a dual beam forward scatter system. The reported work demonstrates that valuable measurements of boundary-layer velocity profiles can be made in subscale combustion MHD generator channels despite the problems associated with high velocity, high temperature, and difficulty of access.

S.D.

**A79-49136** # Latent heat-of-fusion energy storage - Experiments on heat transfer from cylinders during melting. A. G. Bathelt, R. Viskanta, and W. Leidenfrost (Purdue University, West Lafayette, Ind.). (American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, Palo Alto, Calif., May 25, 26, 1978, ASME Paper 78-HT-47) ASME, Transactions, Journal of Heat Transfer, vol. 101, Aug. 1979, p. 453-458. 15 refs. NSF Grant No. ENG-75-15030.

Melting from an array of three staggered, electrically heated cylinders imbedded in a paraffin (n-octadecane) has been studied.

The shape of the melting front has been determined photographically, and the local heat transfer coefficients were measured using a shadowgraph technique. The experiments provide conclusive evidence of the important role played by natural convection on the timewise variation of the melt shape, the surface temperature and the instantaneous local as well as circumferentially averaged heat transfer coefficients around the imbedded heat sources. After a common solid-liquid interface is formed around the cylinders, natural convection circulation around each cylinder interacts strongly with the other two cylinders. The arrangement of heat sources affects significantly the melt shape but the circumferentially averaged instantaneous heat transfer coefficients differ only by about 10 percent for the two arrangements studied. The experimental findings indicate that natural convection effects are important and should be considered in analysis and design of systems involving phase change.

(Author)

**A79-49158** Small-scale coal-gasification plants. A. Verma (Saskatchewan Power Corp., Regina, Canada) and P. J. Read (Department of Energy, Mines and Resources, Ottawa, Canada) Energy Sources, vol. 4, no. 3, 1979, p 281-297. Research supported by the Saskatchewan Power Corp. and Department of Energy, Mines and Resources.

This paper presents technical and economic analyses of coal-gasification processes to manufacture medium-heating-value gas and synthetic natural gas from two commercially available processes: Koppers-Totzek and Lurgi. The plants were designed for a capacity of 30 x 10 to the 9th Btu/day.

(Author)

**A79-49179** # Photovoltaic cell with bilateral sensitivity (Fotopreobrazovatel' s dvukhsstoronnei chuvstvitel'nost'iu). Iu A. Anoshin, N. M. Bordina, A. K. Zaitseva, V. A. Letin, and N. A. Milovanova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnykh Toka, Moscow, USSR) Geliotekhnika, no. 2, 1979, p 3-8 6 refs. In Russian.

In the present paper, the current-voltage equations are derived for a photovoltaic cell with a n(+)-p-p(+) heterojunction, both for illumination of the isotopic junction and for simultaneous illumination of the isotopic and p-n junctions. The influence of the base and p(+) layer parameters on the performance of the cell is studied, and some experimental data are discussed.

V P.

**A79-49180** # Wideband graded-band-gap Ga/1-x/Al/x/As-Si photoelectric cells with n-region illumination (Varizonnnye shirokopolosnye Ga/1-x/Al/x/As-Si-fotoelektropreobrazovatel'i s osveshchaniem n-oblast'iu). A. Berkeliev, V. N. Bessolov, A. N. Imenkov, N. Nazarov, B. V. Tsarenkov, and Iu P. Iakovlev (Akademiya Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR, Akademiya Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) Geliotekhnika, no. 2, 1979, p 9-12. In Russian.

**A79-49181** # Dependence of the photoelectric parameters of photovoltaic cells on illuminance (Zavisimost' fotoelektricheskikh parametrov fotopreobrazovatel'ei ot osveshchennosti). E. B. Vinogradova, T. M. Golovner, S. M. Gorodetskii, and L. B. Kreinin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) Geliotekhnika, no. 2, 1979, p 13-17 7 refs. In Russian.

In the experiments described, the recombination characteristics and spectral sensitivity of photovoltaic cells were studied as a function of the illuminance level. The nature of bulk defects in the cell structure is studied for cells with a nonlinear lux-ampere characteristic.

V P.

**A79-49182** # Analysis of the optical characteristics of silicon photovoltaic cells with bilateral sensitivity (Analiz opticheskikh kharakteristik kremnievykh fotopreobrazovatel'ei s dvukhsstoronnei chuvstvitel'nost'iu). V. R. Ziaevlin, V. A. Letin, and N. M. Kholeva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) Geliotekhnika, no. 2, 1979, p 18-22 7 refs. In Russian.

In the present paper, the optical characteristics of bilaterally illuminated photovoltaic cells are analyzed with the object of assessing the effectiveness of their production technology and calculating their equilibrium temperature with allowance for infrared and reflected solar radiation. The results of the analysis can be used to control current losses and to modify the production technology

V P

**A79-49183 # Calculation of the optical characteristics of high-power two-mirror solar furnaces (Raschet opticheskikh kharakteristik dvukhzerkal'nykh solnechnykh pechei bol'shoi moshchnosti).** S A Azimov, Kh M Mallaeva, I I Pirmatov, T T Riskiev, and S Kh Suleimanov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no. 2, 1979, p. 23-28. 9 refs. In Russian

A method of designing large solar furnaces is proposed. For illustration, the method is applied to the design of a two-mirror solar furnace and a tower-mounted solar plant

V P

**A79-49184 # Method of calculating heat storages for solar heating systems (K metodike rascheta akkumulatora tepla sistemy solnechnogo obogreva).** O Azimov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) and R R Avezov (Samarkandskii Gosudarstvennyi Universitet, Samarkand, Uzbek SSR) *Geliotekhnika*, no. 2, 1979, p. 29-32. 6 refs. In Russian

**A79-49185 # Investigation of the aerodynamic resistance of solar air heaters (Issledovanie aerodinamicheskikh soprotivlenii solnechnykh vozdukhonagrevatelei).** S O Khatamov, R R Avezov, and G G Umarov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no. 2, 1979, p. 48-54. 7 refs. In Russian

The paper deals with a theoretical and experimental study of the dynamic resistance of five representative solar air heaters of the hot box type. All the heaters studied were 1 m long, 0.64 m wide, and 0.175 m thick. Good agreement between theory and experiment is established

V P

**A79-49186 # Investigation of the absorption and emission characteristics of an ideal selective surface (Issledovanie pogloshchatel'no-izluchatel'nykh kharakteristik ideal'noi selektivnoi poverkhnosti).** O I Kudrin and A Abdurakhmanov *Geliotekhnika*, no. 2, 1979, p. 55-62. 6 refs. In Russian

A method for calculating the absorptivity and emissivity of a selectively absorbing surface is proposed, along with a technique for calculating the optimal threshold wave length. An improved analytical definition of an ideal selective surface for solar heating purposes is given

V P

**A79-49207 Thermal emissivity of selective surfaces - New lower limits.** D M Trotter, Jr. and A J Sievers (Cornell University, Ithaca, N.Y.) *Applied Physics Letters*, vol. 35, Sept. 1, 1979, p. 374-376. 16 refs. NSF Grant No. DMR 76-81083, Contract No. EG 77-S-03-1456

Numerical calculations of the thermal emissivity epsilon of spectrally selective surfaces consisting of absorbing films on reflective metal substrates are reported. A physically realizable form for the absorption coefficient of the film, and a refractive index derived from this coefficient via a Kramers-Kronig relation were used to obtain new lower limits for epsilon

(Author)

**A79-49210 Interferometry of a gas-puff z-pinch plasma.** J Shiloh, A Fisher, and E Bar-Avraham (California, University, Irvine, Calif.) *Applied Physics Letters*, vol. 35, Sept. 1, 1979, p. 390-392. 5 refs. Research supported by the U.S. Defense Nuclear Agency

A nitrogen laser interferometer is utilized to study the density profile of a gas-puff z-pinch plasma during the implosion stage and the final collapse. The density profile and the plasma stability as a function of the different parameters are reported

(Author)

**A79-49211 \* Extension of a theorem used in the investigation of P-N junctions with the scanning electron microscope to arbitrary geometries and arbitrarily inhomogeneous material.** O. von Roos (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Applied Physics Letters*, vol. 35, Sept. 1, 1979, p. 408, 409

**A79-49213 Temperature dependence of the current-voltage characteristics of silicon MIS solar cells.** J Shewchun, R Singh, D Burk, and F. Scholz (McMaster University, Hamilton, Ontario, Canada, Brown University, Providence, R.I.) *Applied Physics Letters*, vol. 35, Sept. 1, 1979, p. 416-418. 13 refs. Research supported by the National Research Council of Canada and U.S. Department of Energy

Measurements of the dark I-V characteristics of Al-SiO<sub>2</sub>(x)-p-type Si solar cells as a function of temperature have been used to elucidate one of the possible current conduction mechanisms in MIS solar cells. A good fit is obtained by using the diffusion current mechanism as described previously in the authors' theory of MIS solar cells. There is little evidence in the data on the authors' devices to support the thermionic emission model which is the alternate mode of operation proposed by other investigators

(Author)

**A79-49215 Current conduction in Cr-MIS solar cells on single-crystal p-silicon.** K Rajkanan and W. A. Anderson (New York, State University, Amherst, N.Y.) *Applied Physics Letters*, vol. 35, Sept. 1, 1979, p. 421-423. 5 refs. Contract No. ET-78-R-03-1876

New information has been obtained about the current conduction in Cr-MIS solar cells by studying their current-voltage relationship over a wide range of temperatures. It is demonstrated that majority-carrier tunneling over the combined barrier due to the interfacial oxide and the space-charge region dominates the I-V characteristics at temperatures below 250 K for Cr-SiO<sub>2</sub>(x)-(p-Si) solar cells. Insight about the shunt resistance and back-contact barrier is also obtained by plotting the activation energy versus applied bias. Majority carriers tunneling via interface states control the characteristics at higher temperatures for these devices, made on 0.4-ohm cm p-silicon

(Author)

**A79-49224 Lockheed urges hydrogen fuel.** *Interavia*, vol. 34, Sept. 1979, p. 872, 873

The use of hydrogen as a future aircraft propellant is discussed and some advantages and disadvantages of using methane as another alternate source are examined. Although hydrogen is seen as a dangerous fuel source, its advantages clearly outweigh its disadvantages. First, it is noted that because hydrogen is lighter than air, a fire ignition would tend to roar upward and not expand sideways like a liquid fuel fire. Second, hydrogen burns cleanly and consistently, providing considerable benefits in the design of future power plants. Last, its exhaust consists mainly of water and therefore a hydrogen-fueled engine would create even less air pollution than the cleanest of modern petroleum-burning turbofans. The only disadvantage noted here is the apparent danger because of its high combustibility, and it is concluded that hydrogen may be the best alternative to many present-day energy problems

C F W

**A79-49227 R&D programmes in the field of hydrogen economy.** G. Imarisio (Commission of the European Communities, Brussels, Belgium) *International Journal of Hydrogen Energy*, vol. 4, no. 3, 1979, p. 179-186. 7 refs.

The paper presents a survey of the prospects of hydrogen in the future energy market as well as a review of research and development programs in the field of hydrogen. Programs discussed include thermochemical hydrogen production, electrolytic hydrogen production and other production methods such as photochemical and photobiological. Attention is given to the corresponding efforts of each country. Finally, a rough estimate is made of the overall present R&D effort in the field of hydrogen and the possible outcomes are suggested.

M E P

**A79-49228** Mobile electrolytic hydrogen generators N. J. Louw (Stellenbosch, University, Stellenbosch, Republic of South Africa) *International Journal of Hydrogen Energy*, vol 4, no 3, 1979, p 187-192

A small mobile electrolytic hydrogen generator was developed and built in order to provide hydrogen gas for the filling of meteorological balloons in the field and at temporary and remote weather stations. The capacity of the unit is 2 standard cu m/h (H<sub>2</sub>) and utilizes 25 cells with an electrode area of 0.10 sq m each. The hydrogen gas is compressed to fill steel cylinders at 17 MPa gage. Electrical power for the plant is supplied from a separate generating set on its own trailer. The trailer with plant has a mass of 4.25 tonne on a deck area of 3.92 x 1.64 sq m. (Author)

**A79-49231** The impracticability of large-scale generation of hydrogen from water photolysis by utilization of solar radiation. A. Melvin (British Gas Corp., London, England). *International Journal of Hydrogen Energy*, vol 4, no 3, 1979, p. 223, 224.

The possibility of using solar radiation for the generation of hydrogen by the photolysis of water is discussed in relation to requirements of large-scale generation which would be needed in a hydrogen economy or in coal gasification. Although the point is conceded that solar energy is, for all practical purposes, an infinite source, the conclusion is that solar radiation is not available on the surface of the plant in energy densities which would allow large-scale hydrogen generation without overwhelming technical and economic difficulties. The particular restriction lies in the large ground areas required for generation of reasonably large quantities of hydrogen, since the volume of hydrogen at atmospheric pressure which can be generated per square metre of surface is only of the order of 0.2-0.4 cu m/day. (Author)

**A79-49254** Molybdenum, carbon and silicon carbide limiter experiment in the JFT-2 tokamak. Y. Gomy, S. Konoshima, N. Fujisawa, S. Kasai, M. Maeno, N. Suzuki, T. Hirayama, and M. Shimada (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). *Japanese Journal of Applied Physics*, vol 18, July 1979, p 1317-1324. 29 refs

Molybdenum, pyrolytic graphite (PG), and silicon carbide were used for the limiter of the JFT-2 tokamak. It was found that the macroscopic discharge characteristics with the PG and SiC limiters were equivalent to those with the Mo limiter, though CV line radiation with the PG and SiC limiters was 1.3 to 6 times that with the Mo limiter. For these conditions, the maximum surface temperature of the limiter during discharge was 550 C for Mo, 1900 C for PG, and 1000 C for SiC, as observed by an infrared camera. Residual gas analysis indicated that chemical reaction between the plasma and the limiter did not play a major role in carbon generation into the plasma. The estimated amount of carbon contamination of the plasma can be caused by physical sputtering, which has been separately investigated for PG. (Author)

**A79-49300** The influence of demand development and resource proposals on the production of basic chemicals - Estimations with the aid of a simulation model for the year 2000 (Der Einfluss von Nachfrageentwicklung und Rohstoffangebot auf die Produktionsstruktur von Grundchemikalien - Abschätzungen mit Hilfe eines Simulationsmodells bis zum Jahre 2000). E. Böhm, H. Herz, and E. Jochem (Fraunhofer Gesellschaft zur Förderung der angewandten Forschung, Institut für Systemtechnik und Innovationsforschung, Karlsruhe, West Germany) *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol 32, Aug 1979, p 399-403. 8 refs. In German.

An examination of present and future fossil fuel consumption rates as well as other raw material reserves are discussed with an overview of the next 20 years, employing an optimization model. The model involves a multiple-linear regression method for projecting consumption amounts. Estimates for demand and export trade are

made with respect to domestic needs and expectations of technological advancement. The simulation model will enable accurate projections of the changes in development due to fossil fuel mining, and bridge the gap between macroeconomic models and industrial models that are used to determine optimal production capability. Various chemical block diagrams and raw material flow charts are presented outlining the processes of converting raw materials to useable end products. C F W

**A79-49330** The Eppler scenario - A critical analysis (Das Eppler-Szenario - Eine kritische Analyse) H. Michaelis *Energiawirtschaftliche Tagesfragen*, vol 29, Aug 1979, p 455-461. In German.

The paper examines Eppler's anti-nuclear energy strategy (1979) for West Germany, with emphasis on the necessary guidelines for implementation as well as the economic consequences of future energy provisions. Two goals of energy policy are outlined: (1) to balance current energy demand against energy supply and (2) to slow down energy consumption without reducing energy production. Eppler's main concern is to stabilize the consumption rate at 580 TWh by the year 2000, which would result in an annual energy increase of only 2.1%. This can be achieved by employing more coal, oil and natural gas instead of expanding nuclear energy, and by implementing better and more efficient insulation systems. A summary is presented which analyzes the advantages and disadvantages of the proposed system, emphasizing discrepancies between Eppler's ideas and research conducted by the German Institute of Economic Research. C F W

**A79-49331** Dialectical discussion on optimal order structures for an integrated energy supply system (Zur Dialektik der Diskussionen um optimale Ordnungsstrukturen der leistungsgelinkten Energieversorgung) G. Cwienk (Stadtwerke, Tübingen, West Germany) *Energiawirtschaftliche Tagesfragen*, vol 29, Aug 1979, p 472-481. 22 refs. In German.

A pluralistic order structure is compared to a mono-hierarchical structure for the West German energy supply system. The development of the system is analyzed with emphasis on the energy preamble of the 1935 energy structure policy document and the advocates and opponents of its implementation to date. The demands on the existing structure are examined with respect to the interaction between the regional and local bureaucracies and as an example, attention is given to the structure of a government-sponsored public electric utility, with emphasis on the responsibilities of each of the local governments. C F W

**A79-49345 \* #** Characterization of a swept-strut hydrogen fuel-injector for scramjet applications. G. B. Northam, C. A. Trexler, and G. Y. Anderson (NASA, Langley Research Center, Hampton, Va.) *Joint Army-Navy-NASA-Air Force, Interagency Propulsion Committee Combustion Meeting, 15th, Newport, R.I., Sept 1978, Paper 19*. 5 refs.

Results of an experimental investigation of a swept-strut hydrogen fuel-injector simulating the center strut of a three strut scramjet module at Mach 6 flight conditions are presented. Detailed wall pressure distributions from over 100 separate tests with overall fuel flow from 0.1 to 1.3 times stoichiometric and test gas stagnation temperature from 1100 to 2400 K were recorded. The distance for pressure rise from the point of injection was found to increase with increasing test stagnation temperature. This trend indicates that chemical kinetics in the immediate region of perpendicular injection are not likely to be the mechanism controlling the onset of pressure rise. A fluid dynamic mechanism is suggested involving separation of the boundary layer downstream of injection which is forced upstream from the trailing edge by pressure rise due to combustion occurring in the base region of the strut. The results obtained indicate that the swept-strut fuel-injector concept can be adapted to a wide range of flight conditions by varying the amount of perpendicular fuel injection. (Author)



**A79-49357** The isotopic composition of carbon in the Alberta oil sand. K. N. Jha, J. Gray, and O. P. Strausz (Alberta, University, Edmonton, Canada). *Geochimica et Cosmochimica Acta*, vol. 43, Sept. 1979, p. 1571-1573. 25 refs. Research supported by the National Research Council of Canada, Department of Energy, Mines and Resources, and Imperial Oil Enterprises

**A79-49372 #** Effect of load factor on the characteristics of series MHD generators (Vliianie koeffitsienta nagruzki na kharakteristiki seriesnykh MGD-generatorov). G. P. Bazarov, E. N. Kufa, and S. A. Medin. *Magnitnaia Gidrodinamika*, Apr.-June 1979, p. 99-104. In Russian.

Local and integral characteristics of singly loaded series MHD generators operating under partial loads are investigated. Two-dimensional channels with perfectly sectioned electrodes having different types of sectional connection are considered. The flow parameters and channel height are assumed to be constant, and the calculations are performed by the finite-difference technique. It is shown that in the region where the current-collecting electrodes join a sectioned part of the channel, a significant increase in electric-field density is possible when the load factor is changed. F G M

**A79-49373 #** Induced fields during the motion of a conducting medium in the field of an air-core magnetic system (Indutsirovannyye polia pri dvizhenii provodiashchei sredy v pole bezzhelaznoi magnitnoi sistemy). A. M. Anisimov, V. F. Vasil'ev, I. V. Lavrent'ev, and V. L. Ovchinnikov. *Magnitnaia Gidrodinamika*, Apr.-June 1979, p. 136, 137. In Russian.

An equation is obtained which describes the distribution of the magnetic field induced in a conducting medium when that medium moves in the transverse field of an air-core magnetic system. It is shown that the channel height, rather than its width (as is the case for ferromagnetic systems), is the characteristic linear dimension involved in the magnetic-Reynolds-number determination. Experiments performed with electrically conducting films moving in the field of two Helmholtz coils are discussed which demonstrate that the experimental data are in completely satisfactory agreement with a computer-aided solution to the equation obtained. F G M

**A79-49374 #** Characteristics of series channels with a reduced electrode commutation angle in the connecting section (Kharakteristiki seriesnykh kanalov s umen'shaiushchimsia uglom kommutatsii elektrodov na perekhodnom uchastke). G. P. Bazarov and E. N. Kufa. *Magnitnaia Gidrodinamika*, Apr.-June 1979, p. 138-140. In Russian.

Local and integral characteristics of singly loaded series MHD generators with a reduced electrode commutation angle in the connecting section are investigated. Boundary-value problems for two-dimensional channels with constant flow properties and a magnetic field that varies along the channel are solved by the finite-difference method, the parameters of the solution are the position of the channel with respect to the magnetic field and the connecting-section geometry. It is shown that the integral characteristics of the generators considered are not degraded under rated operating conditions and that channels with a smaller commutation angle are more stable under alternate operating conditions. F G M.

**A79-49376** Utilization of alternative fuels for transportation, Proceedings of the Symposium, University of Santa Clara, Santa Clara, Calif., June 19-23, 1978. Symposium sponsored by the U.S. Department of Energy. Edited by M. Newman and J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc. (AIAA Aerospace Assessment Series, Volume 2), 1979. 244 p. \$15

This overview of alternative fuel development deals with such issues as energy supply and fuel manufacturing/processing and storage and distribution. Attention is given to fuels for both road

vehicles and nonroad vehicles (e.g., aircraft and trains). Finally, discussions on impacts and institutional issues are presented. B J

**A79-49377 #** Future transportation fuels. M. R. Adams (U.S. Department of Energy, Washington, D.C.) In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 9-40.

The paper presents an overview of the expected future need for alternative transportation fuels, including an assessment of the potential of conservation technologies for reducing future fuel demand. The institutional barriers that may impede the introduction of new transportation fuel systems into the national infrastructure are described and consideration is given to the expected trend of shifting from primary gasoline consumption to a preponderance of consumption of middle distillates during the remainder of this century. A review of the technological, economic, and environmental/safety status of various alternative fuel candidates is presented and the role of government in accelerating the adoption of new technologies is assessed. B J

**A79-49378 #** Storage and distribution of cryogenic fuels. W. E. Timmcke (Air Products and Chemicals, Inc., Allentown, Pa.) In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 59-69.

The paper reviews the state of the art of storage and distribution equipment for cryogenic fuels (LNG and LH2) and discusses applications to various transportation modes. It is found that the capability to store and transport these potential fuels is well within the designers' expertise and that the evolution of a total support system for a specific transportation vehicle will improve skills already developed. B J

**A79-49379 #** Storage and distribution of synthetic fuels. J. E. Berger (Shell Oil Co., Houston, Tex.) In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 69-79.

The paper discusses the storage and distribution of noncryogenic 'conventional' synthetic fuels. The scope of the discussion is limited to reasonably foreseeable alternate synthetic fuels in the transportation industry, particular attention is given to automotive applications for a time frame of the order of 15 years. Consideration is given to the specific problems that synthetic fuels may pose to the transportation and distribution network which now exists. B J

**A79-49380 #** Outlook for electric road vehicles. W. Hamilton (General Research Corp., Santa Barbara, Calif.) In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 97-106.

Electric vehicles in very large numbers could be recharged from coal or nuclear facilities now available or projected at U.S. utilities. Resultant savings of petroleum could be correspondingly large. With future batteries, the driving range of electric cars will become adequate for most automotive travel. Unless gasoline prices increase drastically in relation to oil prices or government intervenes directly, however, relatively few electric cars are likely to be sold in this century, because they generally will cost more and do less than conventional cars. (Author)

**A79-49381 # Alternative fuels in aviation** J G Borger (Pan American World Airways, Inc., New York, N.Y.). In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p 129-142

The state of the art and expected future advances of alternative fuels in aviation are discussed. Consideration is given to uses of liquid hydrogen and methane, broadening of turbine fuel specifications, increased aromatics, decreased flashpoint, increased freeze point, thermal stability, synthetic fuels, and the refinery process. It is noted that major fuel efficiency improvements resulting from the NASA ACEE program probably will not appear before the late 1980s. B.J

**A79-49382 # Outlook for the development of hybrid fuels** C A Moses (Southwest Research Institute, San Antonio, Tex.). In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p 142-147

Hybrid fuels, defined as finished fuels derived from combinations of different energy sources, are examined for their potential in conserving petroleum in the transportation sector. Carbonaceous slurries and diesel fuel blends with water and/or alcohols offer the greatest potential. Problems appear solvable in the near future. (Author)

**A79-49383 # A general history of the Nebraska Grain Alcohol and Gasohol Program.** C R Fricke (Agricultural Products Industrial Utilization Committee, Lincoln, Neb.). In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 155-162. Research supported by the Agricultural Products Industrial Utilization Committee.

**A79-49384 # The Seattle experience - Conversion of solid waste to fuels or chemicals** J K Coyne (Coyne Chemical Co., Philadelphia, Pa.). In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p 162-174.

This paper discusses the efforts of the city of Seattle, Washington, the Coyne Chemical Company, the former Energy Research and Development Administration, and other public and private sector participants to develop a full-scale solid waste to methanol/ammonia plant. Nearly four years of analysis, research, and development ended in May 1977, with the decision to cancel the program. A series of significant economic, social, bureaucratic, and organizational constraints to the effective implementation of large-scale alternative energy programs is evaluated. The hypothesis is offered that the existing unwillingness of venture capital sources to accept the risks inherent in alternative energy development, coupled with the procedural difficulties of marshaling public sector acceptance and support, will conspire effectively to prohibit the completion of any major alternative fuel development programs over the near term. (Author)

**A79-49385 # Synthetic fuels program** C L Stone. In Utilization of alternative fuels for transportation, Proceedings of the Symposium, Santa Clara, Calif., June 19-23, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p 175-182.

The paper reviews a synthetic fuels program proposed and developed by the California Legislature. The discussion highlights alternative fuels for transportation, and the uses of methanol-X and gasohol as automotive fuels. B.J

**A79-49401 Review - Thermophysical properties of oil shales.** K Rajeshwar, R Nottenburg, and J Dubow (Colorado State University, Fort Collins, Colo.). *Journal of Materials Science*, vol 14, Sept. 1979, p. 2025-2052. 173 refs. Research supported by the U.S. Department of Energy and NSF.

Recent developments in the characterization of the thermophysical properties of various types of oil shales are reviewed. Changes in the thermal, mechanical and electrical properties of these technologically important materials are discussed, with temperature and organic content as the experimental variables. Structural models are presented to aid in predicting the variation of thermophysical parameters with organic content in the shale. Comparison of calculated results with experimental data are shown with thermal diffusivity as a representative parameter. Areas where further research of a fundamental nature would be of a particular relevance are also highlighted in the review. (Author)

**A79-49423 The rough road to making oil and gas from coal.** A Stuart. *Fortune*, vol 100, Sept 24, 1979, p 50-52, 57, 60, 62, 64.

Methods for developing oil and gas from coal are examined. Attention is given to past (German) coal gasification methods as well as new developments of existing processes, stressing the increasing costs of gas and its effects on present production. Emphasis is given to coal gasification and the problems that are encountered, noting ways to cope with 'caking' coals. The process of coal liquification to produce methanol is described and four second-generation techniques are mentioned including solvent refined coal, Exxon donor solvent, and H-coal. C F W

**A79-49424 Solar comes out of the shadows** C G Burck. *Fortune*, vol 100, Sept 24, 1979, p 66-70, 73, 75.

The paper discusses the problems encountered in developing solar energy to meet the governmental goal of employing 20% of the total energy need from solar means by the year 2000. Various present solar energy systems are examined including space-heating systems and evacuated-tube collectors. Some of the major problems encountered in solar-housing systems are that, although simple, these systems are actually highly complex, require infinite detail to function effectively and need better systems designs. An example is incident solar energy, which may vary between 10 and 25% at different sites within a region, due to microclimatic conditions. Attention is given to new silicon-based designs for photovoltaic cells as well as designs for pure silicon cells that generate large amounts of stored energy. C F W

**A79-49425 Biomass - The self-replacing energy resource** G Bylinsky. *Fortune*, vol 100, Sept 24, 1979, p 78, 79, 81.

The use of biomass as an alternative energy source, focusing mainly on coal and wood. The advantages of employing coal burning for ethanol distillation plants are discussed as well as methods of ethanol extraction from corn. Other energy sources are also discussed which include utilizing unharvested, new-grown hardwood that accounts for 55% of the total wood growth. It was determined that forest growth could be doubled if the problem of inadequate harvesting equipment could be overcome. Attention is given to wood-chip-burning house-heating systems and also to fast growing water plants, that can be harvested and converted into methane and fertilizer. C F W

**A79-49475 A quantitative comparison of energy costing methods.** A El-Sawy, J G Leigh, and R K Trehan (Mitre Corp., McLean, Va.). *Energy Systems and Policy*, vol 3, no 2, 1979, p 213-226. 19 refs.

This paper presents a review and analysis of methodologies used for estimating electricity generation costs, with particular reference to geothermal energy, although the main conclusions apply equally to other sources of electricity. The costs projected by the different methods for two test cases are presented, and estimates are made of the sensitivity of the results to critical methodological choices. (Author)

**A79-49479 Computer simulation of a solar energy system.** J M Key *Sunworld*, vol 3, no 4, 1979, p 96-101

A solar heating and cooling system designed for use at the El Camino Real School in Irvine, California is presented. The solar energy is collected by banks of evacuated glass tube collectors mounted on tilted platforms on the roof of the school and provide an effective collector area of 5000 sq ft. Along with the government-sponsored design and construction of the system, a computer simulation based on a mathematical model was also constructed. A two-phase simulation was described: first, the system model was driven by a weather model from data collected over the past few years and second, a TRNSYS program was run with weather data measured from the previous year. It was concluded that (1) the solar fraction was higher for the storage tank system than for the heat exchanger system at any time of the year and at any boiler setpoint and (2) the solar fraction was much less sensitive to boiler setpoint when there exists a storage tank. C F W

**A79-49487 \* # Applications of free-space microwave power transmission.** S W Fordyce (NASA, Office of Space and Terrestrial Applications, Washington, D C) and W C Brown (Raytheon Co., Lexington, Mass.) *Astronautics and Aeronautics*, vol 17, Sept 1979, p 54-59, 61 8 refs

Some applications and properties of free-space power transmission are examined. Among the properties discussed are: no mass, either in the form of wire conductors or ferrying vehicles, is needed between the source of energy and the point of consumption; energy can be transferred at the velocity of light; no loss of energy in transferring energy through the vacuum of space; and the energy transfer is insensitive to a difference in the gravitational potential of the transmitter and receiver locations. Applications discussed include the Solar Power Satellite, high altitude platforms for communications and remote sensing. Also discussed are rectennas and retro-directive arrays. Finally, an expression yielding minimum cost is presented. M E P

**A79-49488 Battery systems for electric vehicles - A state-of-the-art review.** D A J Rand (Commonwealth Scientific and Industrial Research Organization, Institute of Earth Resources, Melbourne, Australia) *Journal of Power Sources*, vol 4, Aug 1979, p 101-143 176 refs

The future economy demands the development of more efficient power sources for urban vehicles. These sources could be electrochemical systems, i.e., batteries or fuel cells or battery-fuel cell hybrids. The purpose of this paper is to review the current world effort being directed towards developing advanced battery systems for electric vehicle power source applications. The relative merits of the various battery types under examination will be discussed in terms of their efficiency, performance, convenience, cost, and the availability of their component active materials. These factors are important in deciding whether a particular system will be suitable for use in electric vehicles. (Author)

**A79-49489 The theory of stabilization of the output power of a rechargeable fuel cell battery under conditions of significant concentration polarization.** I G Gurevich (Akademiya Nauk Belorusskoi SSR, Institut Teplo- i Massoobmena, Minsk, Belorussian SSR) *Journal of Power Sources*, vol 4, Aug 1979, p 145-164 10 refs

A theory is developed for the output power stabilization of a rechargeable fuel cell battery in which the reactants and the electrochemical reaction products are in the electrolyte. Possible means of voltage stabilization are considered which employ continuous-flow and continuous flow-circulation supply of the working solution (electrolyte) to a fuel cell. Expressions are derived for the effective stabilization time and the required electrolyte flow rate. For a battery with known output parameters, the means of stabilization have been optimized based on the electrolyte flow rate and time of stabilization. The optimum solution is shown to depend on the net energy losses in implementing the stabilization procedure. (Author)

**A79-49514 A few considerations on new energy source.** L. Neel *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 637-648. In English and French

This general review article discusses such topics as domestic heating for scattered dwellings, domestic and industrial heating in urban areas, solar thermal power systems, photovoltaic conversion, windpower generators, wave power, biomass energy. Attention is also given to the effects of economic problems and inflation, and to long-term perspectives (beyond the year 2000) of new energy sources. B J

**A79-49515 What will be the price for energy tomorrow I - Coal price.** M Ippolito (Charbonnages de France, Service Communauté-Etrangers, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 649-662. In English and French

A general analysis of global coal production costs is presented. Estimates of costs of coal production for European consumption are presented and attention is given to a comparative analysis of global production costs for the year 1975 and predicted costs for the year 2000. B J

**A79-49516 Coal yesterday and tomorrow.** D Erza (National Coal Board, London, England) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 675-684. In English and French

The role of coal in the post-World War II period is briefly reviewed and attention is given to ways coal can be used to meet future energy demands. Coal production requirements are reviewed with emphasis on world coal reserves, accessibility of reserves, lead times, and the environmental impact of mining. Consideration is also given to the environmental impact of coal utilization. B J

**A79-49517 The advance of natural gas.** M Tomanoff (Gaz de France, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 685-695. In English and French

Developments in the European natural gas industry over the past 30 years are reviewed with particular reference to the French situation. Various aspects of natural gas production are reviewed, with emphasis on gas reserves and transportation of liquefied gas. The enormous future potential of natural gas is emphasized. B J

**A79-49518 Energy, development and diplomacy.** A Bressan (Ministère des Affaires Etrangères, Centre d'Analyse et de Prévision, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 707-720. In English and French

The possibilities of developing a global energy policy within the framework of a New International Economic Order are examined. Attention is given to such aspects of the problem as (1) needs of the Third World, (2) energy commercialization and modernization, (3) traditional energy sources and the satisfaction of basic human needs, (4) optimal uses of traditional sources, and (5) more efficient uses of local energy sources. B J

**A79-49519 The economic and political conditions of access to resources of natural gas.** M Renon (Gaz de France, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 737-753. In English and French

Questions relating to natural gas production, consumption, and trade are considered within a global political/economic framework. Attention is given to technical/economic characteristics of gas production (raw-material recovery, transportation, etc.), to implications for the policies of producer and consumer countries, and to the influence of the policies of various countries on the natural gas industry. Future perspectives of natural gas production are briefly surveyed. B J

**A79-49520 The international energy agency - The way ahead.** U Lantzke (International Energy Agency, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 767-777. In English and French

The basic goals of the International Energy Agency (IEA) are (1) the development of an emergency oil-sharing plan for member countries, (2) the development of an information system on the international oil market to keep member countries abreast of current developments, (3) the establishment of a dialogue and cooperation with oil-producing and other oil-consuming countries, leading to the development of a stable worldwide energy supply system, and (4) the achievement of long-term reduction of dependence on imported oil through cooperative efforts in energy conservation, development of alternative energy sources, and energy R&D. This paper reviews the first five years of IEA and considers future perspectives. B J

**A79-49521** **Energy savings.** J. Poulit (Agence pour les Economies d'Energie, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 778-785. In English and French.

Ways to save energy without cutting back on economic growth are discussed and the basic elements of an energy policy (including regulation and information) are examined. A general framework for saving energy without reducing growth is developed, the framework involves the participation of government, consumers, and manufacturers. Ways that financial assistance can induce energy saving in various sectors of the community are investigated. B J

**A79-49522** **Chances for a low energy profile society.** J.-M. Martin (CNRS, Paris, France) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 786-791. 12 refs. In English and French.

Some general remarks are made on the possibilities of reducing energy consumption in the long term future (into the 21st century). Relationships between energy costs and economic growth are discussed. B J

**A79-49523** **Energy and society.** H. R. Linden (Illinois Institute of Technology, Chicago, Ill.) (*American Chemical Society, Symposium on Coal Dilemma II, Colorado Springs, Colo., Feb. 13, 1979*) *Revue de l'Energie*, vol 30, Aug-Sept 1979, p 804-819. In English and French.

This general article discusses such topics as differences in national energy policies, the impact of political and social philosophy on energy policy, and national energy consumption patterns and energy waste. It is concluded that the rapidly growing energy needs of the world will be satisfied only by full utilization of all economically and environmentally acceptable energy sources in a climate of free world trade, combined with an extremely intensive effort of research, development, demonstration, and commercial deployment of new energy technologies by the industrialized countries at budgets similar to what is now invested in defense. B J

**A79-49524** # **Construction of combined solar installations for heating and cooling** (O sozdanii kombinirovannykh solnechnykh ustanovok dlia teplo- i khladosnabzheniia). R. Bairamov, A. Davletov, and A. F. Sokolov (Akademiia Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Akademiia Nauk Turkmensoi SSR, Izvestiia, Seria Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no 2, 1979, p 54-60. 5 refs. In Russian.

Design calculations are presented for solar energy systems intended to provide heating, cooling, and hot water in desert regions. Cost and efficiency analyses are carried out for systems consisting of solar water heaters and paraboloid/cylindrical concentrators. B J

**A79-49526** \* # **Fundamental mechanisms that influence the estimate of heat transfer to gas turbine blades.** R. W. Graham (NASA, Lewis Research Center, Fundamental Heat Transfer Section, Cleveland, Ohio) *American Society of Mechanical Engineers and American Institute of Chemical Engineers, National Heat Transfer Conference, San Diego, Calif., Aug 5-8, 1979, Paper 11* p 32 refs.

Heat transfer problems in aircraft gas turbines required for improved prediction of turbine blade or vane gas-side heat transfer

are examined. Estimates of the heat transfer from the gas to vanes or rotating blades are uncertain due to the complexity of the heat transfer processes, since the gas flow is three dimensional with complex secondary viscous flow patterns that interact with the endwalls and blade surfaces. In addition, upstream disturbances, stagnation flow, curvature effects, and flow acceleration complicate the thermal transport mechanisms in the boundary layers. The thermal state and flow characteristics of the hot gases that enter the turbine blade row, analytical methods for calculating the gas side heat transfer to turbine blades, and flow phenomena such as stagnation, curvature effects, acceleration, secondary flows, and transition that influences local heat transfer rates are discussed. A T

**A79-49527** \* # **Reduction of particulate carryover from a pressurized fluidized bed.** R. W. Patch (NASA, Lewis Research Center, Cleveland, Ohio) *Symposium on the Transfer and Utilization of Particulate Control Technology, 2nd, Denver, Colo., July 23-27, 1979, Paper 20* p.

A bench-scale pressurized fluidized bed combustor (PFBC) constructed with a conical shape to reduce the particulate carryover is examined. The combustor was fed coal and limestone with the coal to air ratio varying from 0.033 to 0.098 (all lean) and the coal to limestone ratio varying from 0.06 to 0.36. Two cone angles were used and it is shown that the average particulate carryover of 2.5 grains/SCF is appreciably less than cylindrical fluidized bed combustors. In addition the carryover was correlated by multiple regression analysis to yield the dependence on bed depth and hence the collection efficiency, which was 20%. Finally, a comparison with a model indicated that the exhaust port may be below the transport disengaging height for most of the tests showing that further improvements could be achieved by increasing the freeboard height of the exhaust port above the bed. M E P

**A79-49762** **Numerical study of drift-Alfven waves in a sheared magnetic field.** K. T. Tsang, J. C. Whitson, and J. Smith (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Physics of Fluids*, vol 22, Sept 1979, p 1689-1699. 21 refs. Contract No. W 7405-eng-26.

The coupled radial eigenmode equations for electromagnetic drift waves in a sheared magnetic field are solved numerically. In addition to the familiar drift eigenmodes, a different set of eigenmodes was found which is the analog of the sheared Alfven waves of local theory in a sheared magnetic field. The drift mode is mainly electrostatic, and the shear Alfven mode is mainly electromagnetic and closely related to the high-order tearing modes.

(Author)

**A79-49921** # **Drag reduction by cooling in hydrogen-fueled aircraft.** E. Reshotko (Case Western Reserve University, Cleveland, Ohio) *Journal of Aircraft*, vol 16, Sept 1979, p 584-590. 28 refs.

Drag reductions are possible for cryo-fueled aircraft by using fuel to cool selected aerodynamic surfaces on its way to the engines. This is because cooled laminar boundary layers in air at subsonic and low supersonic speeds are more stable than adiabatic boundary layers and therefore more resistant to transition to turbulent flow. Calculations for  $M = 0.85$  hydrogen-fueled transport show that drag reductions in cruise of about 20% are within reason. The weight of the fuel saved is well in excess of the weight of the required cooling system. These results suggest that the hydrogen fueled aircraft employing surface cooling is quite attractive as an energy conservative aircraft and warrants more detailed study. (Author)

**A79-50001** **Application of finite element method to analysis of MHD generators.** T. Hara, J. Umoto (Kyoto University, Kyoto, Japan), and O. Matsuda (Kansai Electric Power Co., Inc., Osaka, Japan) *Electrical Engineering in Japan*, vol 98, Mar-Apr 1978, p 14-20. 16 refs. Translation.

The finite element method was used to perform two and three-dimensional analyses of the potential and current distributions inside an MHD generator channel. The conductivity and Hall parameter of the plasma are approximately calculated taking into

account the nonequilibrium ionization. Some results on output power and I-V characteristics are also presented. B.J.

**A79-50007** Running test of 12,000-kW refuse-burning power plant in Tokyo Katsushika refuse-collecting plant. Y. Yamaguchi. *Electrical Engineering in Japan*, vol. 98, Mar.-Apr. 1978, p. 108-121. Translation.

The paper describes tests performed to evaluate the electrical power generation capability of a Tokyo refuse-burning station. Consideration is also given to features of the refuse-burning power station and to its principles of operation. Test results were very satisfactory. B.J.

**A79-50027** Studies of CdSiAs<sub>2</sub> for photovoltaic applications. L. C. Burton, C. F. Smith, Jr., A. F. Carroll, and L. H. Slack (Virginia Polytechnic Institute and State University, Blacksburg, Va.) In *SOUTHEASTCON '79*, Proceedings of the Region 3 Conference and Exhibit, Roanoke, Va., April 1-4, 1979.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 25-28. 24 refs.

Investigations related to the p-type chalcopyrite CdSiAs<sub>2</sub> are reported. Polycrystalline bulk material has been formed by direct fusion of the elements, and thin films have been formed by RF sputtering. The bulk samples are stoichiometric, as measured by means of SEM/EDAX and electron beam microprobe, and have the chalcopyrite structure as determined by X-ray analysis. The thin films are also near stoichiometric, and are amorphous. P-N heterojunctions have been formed using CdS as the n-type material, and a photovoltaic response has been measured. The present status is reviewed, and projections are made for future work. (Author)

**A79-50028 \*** Considerations for accurately determining the maximum power output of solar cells. J. W. Lathrop and J. L. Prince (Clemson University, Clemson, S.C.). In *SOUTHEASTCON '79*, Proceedings of the Region 3 Conference and Exhibit, Roanoke, Va., April 1-4, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 29-32. Contract No. JPL-954929.

The most important single electrical parameter characterizing solar cell performance is P<sub>m</sub>, the cell's maximum power output. In order to experimentally determine P<sub>m</sub> it is necessary accurately to control both illumination and cell temperature during measurements. Two quite different measurement approaches can be used: an equilibrium method and a transient flash method. Both techniques are discussed in the paper in detail. (Author)

**A79-50030** A computer model of a heterojunction solar cell with application to GaP/Si. R. W. Johnson and E. J. Scheibner (Georgia Institute of Technology, Atlanta, Ga.). In *SOUTHEASTCON '79*, Proceedings of the Region 3 Conference and Exhibit, Roanoke, Va., April 1-4, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 37, 38.

A computer simulation model for the heterojunction solar cell is used to study the effect of doping concentration and incident solar radiation on the efficiency and I-V characteristics of the cell. The model is designed to duplicate the results of Sahai and Milnes (1970) for the special case of a GaP-Si cell, but can be easily extended to other materials. The emphasis with this study has been to optimize the design factors for maximum efficiency and also to develop a means by which the operation of the cell can be theoretically assessed after specific degradation effects due to long term environmental exposures. (Author)

**A79-50072 #** Superconductive magnetic energy storage inductor converter units. S. W. Van Sciver and R. W. Boom (Wisconsin, University, Madison, Wis.). In *Midwest Symposium on Circuits and Systems*, 21st, Ames, Iowa, August 14, 15, 1978,

Proceedings. North Hollywood, Calif., Western Periodicals Co., 1978, p. 615-619. 7 refs.

Superconductive magnetic energy storage is being studied by an interdisciplinary group at the University of Wisconsin. To date, the effort has shown that large scale superconducting magnets can provide a technically feasible and economical alternative to pumped hydroelectric storage for utility applications. The unit consists of a superconductive magnet or inductor buried in subterranean bedrock and interfaced to the electric power network by a thyristorized converter of the Graetz bridge type. (Author)

**A79-50073 #** Digital simulation of dynamics of wind turbine generators. H. H. Hwang and T. H. Guo (Hawaii, University, Honolulu, Hawaii). In *Midwest Symposium on Circuits and Systems*, 21st, Ames, Iowa, August 14, 15, 1978, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1978, p. 634-638. 6 refs.

This paper presents a digital simulation of the dynamic stability of a wind turbine generator connected to a power system. The effects of the tower shadow and wind gusts are included in the input to the wind turbine. Different configurations of the drive train and various control methods are used in the simulations. (Author)

**A79-50153 #** Photoelectrochemistry and solar energy conversion (Fotoelektrokhimiia i preobrazovanie solnechnoi energii). Iu. V. Pleskov. *Akademiia Nauk SSSR, Vestnik*, no. 6, 1979, p. 69-76. In Russian.

Two types of photoelectrochemical devices are described: those based on photogalvanic cells and those based on photovoltaic cells. The photoelectrolysis of water is examined in some detail and attention is given to various problems (including efficiency and materials selection) associated with photoelectrochemical conversion. B. J.

**A79-50174** Lateral flow concept for rock bed systems. J. C. Christopher (Contemporary Systems, Inc., Walpole, N.H.). *Solar Engineering Magazine*, vol. 4, Aug. 1979, p. 15-17.

The paper describes the design of a lateral flow concept rock bed system and presents the results of an experiment to determine the breakthrough time and the pressure loss characteristics of a packed stone bed thermal storage device. It is shown that the charging cycle is the exact inverse of the discharge cycle. Data are given showing the temperature of each probe plotted over a continuous 24-hr period as air was fed into the bed at 100 F. It can be seen that each successive point rises almost to the input temperature prior to any significant change in temperature in the succeeding point. The importance of limiting the vertical height of the bin to around 24 in. to prevent vertical stratification is stressed. Finally attention is given to the rock bin insulation. M. E. P.

**A79-50176** Crystal growth and properties of CuGa(x)In(1-x)Se<sub>2</sub> chalcopyrite compound. C. Paolici, L. Zanotti (CNR, Parma, Italy), N. Romeo, G. Sberveglieri, and L. Tarricone (Parma, Università, Parma, Italy). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 3-9. 11 refs. Research supported by the Consiglio Nazionale delle Ricerche.

The preparation of single crystals of CuGa(x)In(1-x)Se<sub>2</sub> by a chemical transport method in a closed tube is described. Electrical and optical properties, measured as a function of CuGa(x)In(1-x)Se<sub>2</sub> composition, indicate that this material, when coupled with zinc and cadmium chalcogenide windows, can be used as an absorber in heterojunction solar cells with near-zero lattice mismatch. (Author)

**A79-50177** Optical properties and structure of amorphous silicon films prepared by CVD. M. Janai, D. D. Allred, D. C. Booth, and B. O. Seraphin (Arizona, University, Tucson, Ariz.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 11-27. 50 refs. Research supported by the AVIAC Foundation, Technion - Israel Institute of Technology and Fulbright-Hays Foundation, Contract No. ER-78-S-02-4899.

**A79-50178** Possibilities of new materials for solar photo-voltaic cells. M. Schoijet (Instituto Politécnico Nacional, Mexico City, Mex.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 43-57. 136 refs.

The requirements for desirable technological properties of semiconductors for photovoltaic conversion are discussed, and two criteria are suggested for the selection of materials that could guide the search toward low-melting-point compounds made of cheap component elements: (1) the use of a deviation from ideality vs. energy-gap diagram for the prediction of energy gaps from the knowledge of melting temperatures or vice versa, (2) the use of the Parthé-Goryunova-Mooser-Pearson criteria for compounds of which only their chemical formula is known but not their structure, in order to guess that structure and therefore be able to use the first criterion. For materials for Schottky devices a third criterion is necessary, derived by Nethercot (1974), that relates the Mulliken electronegativities of the component elements of a compound to its electron affinity. This can also be applied in the search for metallic alloys, semimetals, or narrow-band-gap semiconductors that might replace the metal in a Schottky barrier. It is shown that a number of compounds exist which might meet these criteria. (Author)

**A79-50179** Some relations governing major solar cell parameters. N. M. Ravindra and V. K. Srivastava (Roorkee, University, Roorkee, India). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 59-62. 9 refs.

The method for determining semiconductor materials with an optimum bandgap for photovoltaic conversion is expanded in an attempt to simplify solar cell efficiency or optimum bandgap calculations. The problem is confined to three parameters: temperature, efficiency, and bandgap. A relation is derived stating that the difference in the product of the maximum theoretical efficiency of a solar cell and the corresponding bandgap is a constant, provided that the temperature difference is the same. The relation is valid up to 100°C. V. T.

**A79-50180** Design of selective surfaces for solar energy collection. D. M. Trotter, Jr., H. G. Craighead, and A. J. Sievers (Cornell University, Ithaca, N.Y.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 63-68. 18 refs. NSF Grant No. DMR-76-81083, Contract No. EG-77-S-03-1456.

Numerical calculations have been done to determine the total hemispherical solar absorptivity and the total hemispherical emissivity in the infrared of selective surfaces composed of a dielectric film on a metal substrate. The selectivity of the surface as a function of the refractive index of the film is discussed, as well as the effect of grading the index of the film. It is concluded that the most effective film is one having the index at the metal surface as close to unity as possible through its entire thickness while another, unidentified parameter increases from zero at the front surface to a larger value at the back surface. (Author)

**A79-50181** The surface microstructure optical properties relationship in solar absorbers - Black chrome. A. Ignatiev, P. O'Neill, and G. Zajac (Houston, University, Houston, Tex.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 69-79. 20 refs. Research supported by the U.S. Department of Energy.

**A79-50182** Microstructure of a black chrome solar selective absorber. C. M. Lampert and J. Washburn (California, University, Berkeley, Calif.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 81-92. 9 refs. Research sponsored by the U.S. Department of Energy.

The structure of the 'CHROM-ONYX' type of black chrome/metal selective absorber was studied to gain a better understanding of its influence upon the mechanism of wavelength selectivity. Spectral-reflectance measurements were performed on seven samples. In this study, the best selectivity was found by these measurements to be 1.0 micron of black chrome on copper and 0.7 micron of black chrome on nickel. Both transmission and scanning electron microscopy were employed to study microstructure and chemical composi-

tion. As a result of the combined studies, some effects of black-chrome thickness and the metallic substrate were determined. It was found that black chrome consisted of a very fine metallic distribution of particles of chromium, possibly suspended within a matrix of an oxide of chromium. This combination was, in turn, agglomerated into larger particles within the 0.05-0.3-micron size range. These larger particles formed a network which constituted the surface coating. (Author)

**A79-50183** Composite semiconductors - Selective absorbers of solar energy. J. I. Gittleman, E. K. Sichel, and Y. Arie (RCA Laboratories, Princeton, N.J.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 93-104. 14 refs. Contract No. EG-77-C-02-4557.

Composite semiconductors have been produced by cosputtering  $\text{CaF}_2$  with either Ge or Si, and their optical constants were measured. Their optical behavior can be described as being similar to that of the parent semiconductor, with the same energy gap but with a reduced concentration-dependent index of refraction. The normal specular reflectance of films sputtered on mirrored surfaces was measured. These data were used to compute the solar absorptance and thermal emittance. It was found that the solar absorptance was approximately 0.7 and the thermal emittance, about 0.06 with a weak dependence on composition, thickness, and operating temperatures. Thus at  $T = 500^\circ\text{C}$  conversion efficiencies of 50% are currently possible at solar concentration ratios  $C$  of 7-8 and about 70% for  $C$  of approximately 40, and improved performance can be expected with continuing research. (Author)

**A79-50184** Hemispherical transmittance properties of solar glazings as a function of averaging procedure and incident angle. R. B. Pettit (Sandia Laboratories, Albuquerque, N. Mex.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 125-140. 9 refs. Contract No. AT(29-1)-789.

**A79-50185** Towards the design of contrived photosynthesizers. V. Guruswamy (South Australia, Flinders University, Bedford Park, Australia) and J. O. Bockris (Texas A&M University, College Station, Tex.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 141-156. 33 refs.

Photosynthesis may be contrived to give  $\text{H}_2$  and  $\text{O}_2$ . Biosystems are complex to work with, semiconductors in contact with electrolytic solutions offer more easily comprehended situations and may give enhanced efficiency of conversion of solar light (when compared with bioconversion). What is needed are criteria for optimization: (1) with respect to solid-state factors connected with photoelectrochemical energy conversion, (2) with respect to the competing side reactions which destroy the electrode materials, and (3) with respect to the enhancement of conductivity which is often needed. Some quasi-quantitative numbers are derived. (Author)

**A79-50186** Electric and photovoltaic properties of CdTe pn homojunctions. J. Mimila-Arroyo, Y. Marfaing, G. Cohen-Solal, and R. Triboulet (CNRS, Laboratoire de Physique des Solides, Meudon-Bellevue, Hauts-de-Seine, France). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 171-180. 20 refs.

**A79-50187** Stability of  $\text{SnO}_2/\text{n-Si}$  solar cells. C. Fishman, A. K. Ghosh, and T. Feng (Exxon Research and Engineering Co., Linden, N.J.). *Solar Energy Materials*, vol. 1, Feb. 1979, p. 181-185. Contract No. EY-76-C-03-1283.

$\text{SnO}_2/\text{Si}$  solar cells were encapsulated in Sylgard and then placed in a weatherometer and exposed to a deionized water spray and light from a carbon arc. Other cells were left unencapsulated and placed in a nitrogen dry box and exposed to light from an ELH lamp. Several

cells were placed in quartz jars in a N<sub>2</sub> atmosphere and then hermetically sealed. It is found that the cell behavior is independent of cell preparation. The open circuit voltage decrease is common to all devices made and tested, decaying rapidly and then leveling towards a constant value. Short-circuit current remains constant for all cells, and the fill factor may decrease slightly and then levels. V. T.

**A79-50188 Chromium black coatings for photothermal conversion of solar energy. I - Preparation and structural characterization** J. Spitz, T. V. Danh, and A. Aubert (Commissariat à l'Energie Atomique, Laboratoire d'Etudes des Matériaux Minces, Grenoble, France) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 189-200. 13 refs.

The preparation of selective surfaces on steel and copper substrates by black chrome electroplating is described. The structural characterization of these black chrome surfaces by X-ray diffraction and photoelectron spectrometry is reported. Thermal and chemical stability tests have also been carried out on the surfaces. Finally the conversion efficiencies of black solar collectors which use black chrome and black paint absorbers are compared. (Author)

**A79-50189 Chromium black coatings for photothermal conversion of solar energy. II - Optical properties** J. M. Behaghel, S. Berthier, J. Lafait, and J. Rivory (Paris VI, Université, Paris, France) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 201-213. 9 refs.

The optical characterization of chromium black coatings prepared by electrodeposition at CENG (J. Spitz) is presented. The preparation and the structural characterization of the deposits have been reported in the first part of this paper. The interest of performing measurements of hemispherical reflectivity versus angle of incidence is emphasized. The optical techniques are described. The spectral selectivity of these coatings is determined, discussed and compared to other blacks according to their structure, within the photothermal conversion of solar energy. (Author)

**A79-50190 Back illuminated high efficiency thin film Cu<sub>2</sub>S/CdS solar cells** P. K. Bhat, S. R. Das, D. K. Pandya, and K. L. Chopra (Indian Institute of Technology, New Delhi, India) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 215-219. 14 refs. Research supported by the Ministry of Industrial Development of India.

Backwall Cu<sub>2</sub>S/CdS thin film solar cells of 10.4% conversion efficiency have been fabricated on SnO(x) Sb coated glass substrates by an evaporation technique involving a solid state reaction to form the junction. The cells exhibit an open circuit voltage of 470-490 mV and a short circuit current density of about 37 mA/sq cm under 100 mW/sq cm tungsten illumination. The carrier collection is enhanced as a result of a back surface n+/n junction formed at the SnO(x)/CdS interface. (Author)

**A79-50191 Preparation of titanium dioxide films as solar photocatalysts** D. Haneman and P. Holmes (New South Wales, University, Kensington, Australia) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 233-236. 7 refs. Research supported by the Australian Research Grants Committee.

The use of titanium dioxide as a photoanode in photoelectrolysis cells is well known. It has been prepared as single crystals of rutile, sintered compacts, oxidized titanium sheet, chemical vapor deposited films and evaporated films. Its efficiency for solar energy conversion is generally less than 1%, since it is activated by only 3% of the solar spectrum due to its large (3 eV) bandgap. However it is robust, long lived and suited to direct hydrogen production. Therefore it is of possible economic interest if prepared in sufficiently low cost, large area form. In this report we describe preparation of durable films on low cost substrates with effective ohmic contacts in a simple inexpensive process. (Author)

**A79-50193 Electrochemical solar cells based on layer-type transition metal compounds - Performance of electrode material** H. Tributsch (Max-Planck-Gesellschaft zur Förderung der Wissen-

schaften, Fritz-Haber-Institut, Berlin, West Germany). *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 257-269. 17 refs. Research supported by the Deutsche Forschungsgemeinschaft.

The effect of doping of MoSe<sub>2</sub> (band gap 1.4 eV) as well as the influence of the electrochemical potential of the redox-couple in the electrolyte have been investigated in an effort to optimize solar cells based on layer compounds. It is shown that in the case of I(-)/I<sub>2</sub> the mechanism of photopotential generation is assisted by a favorable chemical modification of the electrode surface which introduces both negative charges into the double layer and traps for holes into the space charge layer. The effect is traced to the formation and reaction behavior of a five valent Mo(V)-I complex. The MoSe<sub>2</sub> I(-)/I<sub>2</sub> cell could be improved to an energy conversion efficiency of 8% for monochromatic and 4% for solar radiation. Its good stability was established by continued operation at 10 mA/sq cm for 10 months. This system cannot compete with solid state solar cells, but it could possibly be developed as hybrid cell for the simultaneous production of heat and electricity. (Author)

**A79-50194 Efficiency of tandem solar cell systems as a function of temperature and solar energy concentration ratio** N. A. Gokcen (U.S. Bureau of Mines Thermodynamics Laboratory, Albany, Ore.) and J. J. Loferski (Brown University, Providence, R.I.). *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 271-286. 11 refs. Contract No. EG-77-C-03-1579.

A comprehensive theoretical analysis of tandem photovoltaic solar cells as a function of temperature and solar concentration ratio is presented. The relation governing the characteristics of the solar cells was derived, and the overall efficiencies of tandem cell stacks of up to 24 cells with energy gaps in the 0.7 to 3.6 eV range were calculated for temperatures up to 500 K, and for illumination by an AMO solar spectrum of 1, 100, 500, and 1000 suns concentration ratios. The calculations show that the optimized overall efficiency for ideal diodes has a limiting value of approximately 70% for 200 K and concentration ratio of 1000. Most of the gain in efficiency occurs between six and ten semiconductors in the tandem system, so that for 300 K and 1000 concentration ratio, an optimized six cell system has a theoretical limit efficiency of about 53%. A.T.

**A79-50195 Role of gap states in discharge produced a-SiH<sub>x</sub> in determining carrier transport and recombination** C. R. Wronski (Exxon Research and Engineering Co., Linden, N.J.) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 287-297. 32 refs.

The role of gap states in determining the transport of recombination of carriers in hydrogenated amorphous silicon (a-SiH<sub>x</sub>) is examined for discharge produced films such as are used in efficient solar cell structures. Junction, photovoltaic and photoconductivity characteristics are presented and discussed for these films. Free carrier transport is found to be present over the temperature range of 400 to 100 K, with the role of states near the free carrier bands being limited to trapping. This is in direct contrast to the previously reported transition from carrier transport to hopping through these localized states and with direct carrier recombination between these states at about 250 K. As a result the recombination kinetics can be directly related to the different states present in the gap of a-SiH<sub>x</sub>, and examples of this are given for both electrons and holes. The recently published reversible conductivity changes must be taken into account if the ambiguities in the interpretation of the kinetics data are to be avoided. (Author)

**A79-50196 Properties of chemically sprayed SnO<sub>2</sub> anti-reflecting films on Si solar cells. I.** Chambouleyron and E. Saucedo (Instituto Politécnico Nacional, Mexico City, Mex.) *Solar Energy Materials*, vol. 1, Mar-May 1979, p. 299-311. 34 refs.

The properties of SnO<sub>2</sub> films obtained by hydrolysis of stannic chloride on silicon surfaces are described. The layers grown by this method possess certain characteristics which make them interesting for photovoltaic applications. Antireflection effects on the Si-air interface are obtained together with a very large reduction of the

surface recombination velocity. This latter effect is explained in terms of hydrogen or chlorine adsorption at the  $\text{SnO}_2\text{-Si}$  interface via the completion of interface dangling bonds. Experimental evidence and theoretical considerations that support such an explanation are given. However, the question of whether or not chlorine could play a passivating role remains open. Finally some considerations are made concerning the possible uses of Sb doped  $\text{SnO}_2$  layers on Si solar cells. (Author)

**A79-50197** **CuInS<sub>2</sub> films prepared by spray pyrolysis.** M Gorska, R Beaulieu, J J Loferski, and B Roessler (Brown University, Providence, RI) *Solar Energy Materials*, vol 1, Mar-May 1979, p 313-317 16 refs NSF Grant No ENG-76-84509, Contract No EG-77-C-03-1579

The electrical, optical and structural properties of thin films of  $\text{CuInS}_2$  prepared by spraying a solution of  $\text{Cu}_2\text{Cl}_2$ ,  $\text{InCl}_3$  and thiourea onto heated glass and alumina substrates are described. The polycrystalline films produced at prescribed spraying rates and substrate temperatures were nearly stoichiometric as shown by EDAX analysis, homogeneous, and had the sphalerite structure. The films were p-type and their resistivity could be adjusted over the range 0.1 ohm cm to very high values by controlling the temperature of the substrate during spraying. Heterojunction devices which exhibited a weak photovoltaic effect were prepared by combining these films with either single crystals of CdS or with sprayed films of CdS. (Author)

**A79-50211** **Energy storage in fluidized beds.** J H Harker and C E Hindmarch (Newcastle upon Tyne, University, Newcastle-upon-Tyne, England) *Institute of Energy, Journal*, vol 52, Mar 1979, p 45-48

A preliminary investigation has been carried out into energy recovery and storage from a low-temperature gas stream in fluidized beds of ballotin particles. Such a system has the advantage of high rates of heat transfer during intake and release of energy and only modest losses of energy during storage. The system is shown to be feasible and a further evaluation of the economics is proposed. (Author)

**A79-50212** **Manufacture of fuel gas for power generation by fluidized bed gasification of coal.** B Robson and G G Thurlow (National Coal Board, Coal Research Establishment, Cheltenham, Glos, England) *Institute of Energy, Journal*, vol 52, June 1979, p 94-99 5 refs. Research supported by the European Coal and Steel Community and National Coal Board

A fluidized bed coal gasification process proposed by Great Britain's Coal Board is outlined. Attention is given to such process requirements such as feedstock, gasifying agents, gaseous products, pressure and choice of gasifier. The results obtained from laboratory-scale experimental work carried out on the gasification stage are described. It is shown that a fuel gas of suitable quality can be produced by adjustment of the operating parameters. Finally, it is noted that a feasibility study on the pilot plant has been completed and indicates areas requiring further study as well as providing preliminary cost estimates. M E P

**A79-50218** **Distributed parameter modelling of urban residential energy demand.** C Clayton and J E Estes (California, University, Santa Barbara, Calif) *Remote Sensing Quarterly*, vol. 1, Jan 1979, p 106-115 10 refs

The paper presents a conceptual model illustrating the potential use of remotely sensed imagery for improving the prediction of residential energy demand in urban areas. The model is composed of four segments: (1) the evaluation, selection, and application of existing econometric models built to predict energy demand, (2) the use of data from remote sensor systems and collateral sources to provide spatially distributed estimates of the magnitude of and change in the independent variables contained in the econometric models, (3) the use of imagery from successive time periods to

construct a predictive land use change model, and (4) the development of a predictive energy demand model based on changing land use patterns. Such a model, when fully operational, could effectively attain two important goals: (1) provide the ability to forecast gross future energy consumption, and (2) have the capability to predict the spatial location of such future demand. The research reported describes a conceptual model designed to predict the magnitude and location of residential energy demand in an urban environment and also predict its future location. (Author)

**A79-50219 \*** **Solar potential inventory and modeling.** G L Angelici and N A Bryant (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *Remote Sensing Quarterly*, vol 1, Apr 1979, p 5-16

Image processing procedures for calculating the energy that roof-mounted solar collectors can potentially supply in a metropolitan area are presented. Satellite multispectral imagery from which land cover types can be determined digitally was sampled in order to estimate the percentage of land area occupied by flat or south-facing roof tops in residential and commercial/industrial areas. Procedures were applied to the various power subdistricts of the western San Fernando valley of California, and it was found that on the average 120% of the existing power demand could be met if only half the useable rooftop area were utilized, amounting to 385 MW of peak power and indicating the applicability of solar cells to power generation in urban areas. A L W

**A79-50327 #** **Evaluation of solar absorbers, reflectors and transmitters - Physical reflectance standards.** J C Richmond (National Bureau of Standards, Gaithersburg, Md) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash, April 30-May 2, 1979

Mount Prospect, Ill, Institute of Environmental Sciences, 1979, p. 2-6 12 refs

The measurement of the solar reflectance and absorption of solar absorbers, reflectors and transmitters is discussed. Consideration is given to the large variations in the observed terrestrial solar spectral irradiance distribution, which are due to atmospheric attenuation by aerosols and atmospheric gasses, and it is argued that a standard solar spectral distribution representing same average air mass and pollutant condition should be adopted. Direct methods of measuring the reflectance and absorption of extraterrestrial solar radiation are discussed, and the indirect measurement of solar properties by means of computations of average absorptance, reflectance and transmittance involving spectral measurements weighted by the terrestrial standard spectrum are considered. The development of physical standards of directional-hemispherical spectral reflectance and spectral specular reflectance by the National Bureau of Standards is also noted. A L W

**A79-50328** **Thermal radiation from conducting surfaces.** A. J Sievers (Cornell University, Ithaca, NY) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash, April 30-May 2, 1979

Mount Prospect, Ill, Institute of Environmental Sciences, 1979, p 7-11 13 refs NSF Grant No DMR-76-81083, Contract No EG-77-S-03-1456

Qualitative arguments are used to derive the essential features of the dependences of the hemispherical thermal emissivity of conducting surfaces on temperature and the DC resistivity of the metal. An expression predicting a linear temperature dependence of the total normal and hemispherical reflectivities is obtained from the free electron model and corrected for the diffuse reflection of conduction electrons from the metal surface. The values obtained from the corrected expressions are shown to be in good agreement with experimental studies on copper and aluminum, and the expressions are used to quantify the heat-trapping ability of solar-selective surfaces. A L W



**A79-50329 # 'Ultra-black' coating for high absorbance of solar energy.** C. E. Johnson (National Bureau of Standards, Gaithersburg, Md.). In: Learning to use our environment, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 12, 13.

Ultra-black surfaces with a spectral reflectance of 0.5% have been produced on electroless nickel-phosphorus coatings. Coatings were applied to copper or steel substrates from the acid Brenner (1947) bath, and the surface morphology leading to the high absorption of the coating was developed by immersing the deposits in a nitric acid solution. Scanning electron microscopy has shown that selective nitric acid dissolution produces honeycomb structure of pores or channels perpendicular to the surface of the coating, which is responsible for its blackness. An average spectral reflectance of 0.5% was measured in the range 320 to 2140 nm, and an emissivity of 50% at room temperature was determined. The low spectral reflectance of the coating may lead to its application in flat plate solar collectors, as well as for low-temperature calorimetry studies. A L W.

**A79-50335 \* Reductions in vehicle fuel consumption due to refinements in aerodynamic design.** E. J. Saltzman (NASA, Flight Research Center, Edwards, Calif.). In: Learning to use our environment, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 63-68, 43 refs.

Over-the-highway fuel consumption and coastdown drag tests were performed on cab-over-engine, van type trailer trucks and modifications of these vehicles incorporating refinements in aerodynamic design. In addition, 1/25-scale models of these configurations, and derivatives of these configurations were tested in a wind tunnel to determine the effects of wind on the magnitude of the benefits that aerodynamic refinements can provide. The results of these tests are presented for a vehicle incorporating major redesign features and for a relatively simple add-on modification. These results include projected fuel savings on the basis of annual savings per vehicle year as well as probable nationwide fuel savings. (Author)

**A79-50342 \* Environmental requirements for flat plate photovoltaic modules for terrestrial applications.** A. R. Hoffman and R. G. Ross, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Learning to use our environment, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 171-178, 9 refs. Research sponsored by the U.S. Department of Energy.

The environmental test requirements that have been developed for flat plate modules purchased through Department of Energy funding are described. Concurrent with the selection of the initial qualification tests from space program experience - temperature cycling and humidity - surveys of existing photovoltaic systems in the field revealed that arrays were experiencing the following failure modes: interconnect breakage, delamination, and electrical termination corrosion. These coupled with application-dependent considerations led to the development of additional qualification tests, such as cyclic pressure loading, warped mounting surface, and hail. Rationale for the selection of tests, their levels and durations is described. Comparisons between field-observed degradation and test-induced degradation show a positive correlation with some of the observed field effects. Also, the tests are proving useful for detecting design, process, and workmanship deficiencies. The status of study efforts for the development of environmental requirements for field-related problems is reviewed. (Author)

**A79-50343 Preliminary testing of a scale model secondary concentrator for the Sandia Solar Thermal Test Facility.** G. P. Mulholland (New Mexico State University, Las Cruces, N. Mex.) and L. K. Matthews (Sandia Laboratories, Albuquerque, N. Mex.). In:

Learning to use our environment; Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 179-182, 5 refs.

A qualitative test of a 3-D Winston-type concentrator at the White Sands Solar Furnace is discussed. The concentrator has an entrance aperture of 15.25 cm, an exit aperture of 7.62 cm, a length of 19.8 cm and a reflective surface of polished aluminum. Nine individually controlled channels have been cut into the wall of the concentrator for cooling water. Wall temperatures at eleven positions and flux-densities at the exit aperture have been obtained. (Author)

**A79-50344 Concentration of a cassegrain solar furnace.** M. H. Cobble, W. C. Hull, and E. F. Thacher (New Mexico State University, Las Cruces, N. Mex.). In: Learning to use our environment; Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 183-187.

A solar furnace consisting of a paraboloid of revolution that tracks the sun, and a hyperboloid of revolution that has a focus in common with the paraboloid is analyzed for the concentration of a nonuniform sun, the concentration of a uniform sun, and the concentration with mirror error. The theoretical results are compared with experimental results for a specific cassegrain solar furnace. (Author)

**A79-50345 Thermal vacuum testing of solarpanels by solar simulation and infrared simulation.** H. E. Nuss (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany). In: Learning to use our environment; Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979.

Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 188-194, 19 refs.

Solar simulation tests for the solar panels of the European Space Agency satellites OTS and Marots were carried out. The performance of the collimated beam solar simulator and the thermal test results are described. As an alternative thermal test method the capability of an infrared radiation method was studied and infrared simulation tests for the ultralight panel (ULP) and the Intelsat V solar panels were performed. The setup and the characteristics of the infrared radiation unit using a quartz lamp array of approximately 15 sq m and an LN<sub>2</sub>-cooled shutter and the thermal test results are presented. The irradiation uniformity, the solar panel temperature distribution, temperature changing rates and temperature gradients for both test methods are compared. The results indicate the infrared simulation is an effective thermal testing method. (Author)

**A79-50346 The availability of solar energy for work processes.** R. H. Edgerton (Oakland University, Rochester, Mich.). In: Learning to use our environment, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 195-200, 13 refs.

The paper discusses the effects of scattering, concentration, and optical filtering on the available energy of solar radiation. NASA standard solar energy absorption data are used to evaluate the effect of atmospheric conditions on the energy in sunlight which can be converted to work. Topics covered include black body radiation, equilibrium thermodynamics, temperature of radiation, solar geometric factors, spectral factors of solar radiation, and available energy of sunlight. M.E.P.

**A79-50347 \* Multichannel temperature controller for hot air solar house.** J. R. Currie (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Learning to use our environment, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 204-208.

This paper describes an electronic controller that is optimized to operate a hot air solar system. Thermal information is obtained from

copper constantan thermocouples and a wall-type thermostat. The signals from the thermocouples are processed through a single amplifier using a multiplexing scheme. The multiplexing reduces the component count and automatically calibrates the thermocouple amplifier. The processed signals connect to some simple logic that selects one of the four operating modes. This simple, inexpensive, and reliable scheme is well suited to control hot air solar systems.

(Author)

**A79-50350 Special considerations in the environmental study program for coal gasification plants.** G. M. Patelunas, A. J. Krause, and E. Berkey (Energy Impact Associates, Inc., Pittsburgh, Pa.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 298-301. 5 refs.

Environmental study requirements are presented for coal gasification facilities during the preconstruction baseline monitoring program. Coal gasification processes are briefly described along with Environmental Impact Statement monitoring programs. Consideration is given to air and water monitoring and the potential environmental impact of solid wastes. This approach will determine the current existence of such major components as CO<sub>2</sub> in air and phenols in water in the natural environment of the proposed plant sites, providing a baseline from which to judge the future performance of coal gasification facilities. V. T.

**A79-50351 Environmental implications for geothermal energy development.** R. B. Craig and G. W. Suter, II (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 302-305. 15 refs. Contract No. W-7405-eng-26.

The nature of geothermal resources and the constraints that site characteristics place on their development are examined. The five types of geothermal energy, magma, normal gradient, hot dry rock, hydrothermal, and geopressurized are discussed, noting that the last three types have potential for near future development. Remoteness of hydrothermal areas which often conflicts with preservation of biological values is considered, and it was found that the most common characteristics of geothermal resource areas is limited water. It was shown that the characteristics of a geothermal field development are drilling activity, water evaporation, a conspicuous plant with cooling towers, dirt roads, pipelines, and transmission lines which interfere with cultural, aesthetic, and wildlife resources. Thus, proper site selection and environmental planning will decide the success of geothermal energy commercialization. A. T.

**A79-50352 Impact of H<sub>2</sub>S emission abatement on geothermal power costs.** K. D. Wells and J. W. Currie (Battelle Pacific Northwest Laboratories, Richland, Wash.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 306-311. 20 refs. Contract No. EY-76-C-06-1830.

Estimates of private costs when abating emissions of hydrogen sulfide from geothermal energy sources are developed. The private costs reflect only the expenses a firm incurs in conjunction with abatement efforts, including charges for such factors as labor, materials, and capital investments. The definition of hydrogen sulfide emissions and impacts are presented as adopted for purposes of cost estimation in the study, along with the associated airborne emission standards for hydrogen sulfide. Hydrogen sulfide emission control processes are reviewed, and cost estimates are provided for those considered economically feasible as well as for a specific geothermal site. V. T.

**A79-50353 Bio-electrochemical conversion of refuse to energy.** K. Denno (New Jersey Institute of Technology, Newark, N. J.) In *Learning to use our environment*, Proceedings of the

Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 316-321. 10 refs. Research supported by the New Jersey Institute of Technology.

The paper presents important results relevant to the processes of synthetic fuel extraction and direct use of the bio-organic fuel in a power cell. The information presented is purely theoretical and based on mathematical and physical concepts. The discussion focuses on the biofuel cell as a perfect electrochemical apparatus, and on the dynamics of bioconversion. This process involves the extraction of multigrade saturated and unsaturated hydrocarbons of the system C(n)H(2n+2) from refuse. This process is assumed to take place through the interaction of material reactants, viz. the refuse and the environment. S. D.

**A79-50354 Problems in the redox flow cell power system for bulk energy storage.** K. Denno (New Jersey Institute of Technology, Newark, N. J.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 322-332. 8 refs. Research supported by the New Jersey Institute of Technology.

The redox flow cell operates on the principle of oxidation-reduction reaction in which the ions of the redox couple remain soluble in their electrolytes in either oxidized or reduced states. The paper focuses on the problem of the internal circulating currents and their causes in the single redox flow cell, especially in the catholyte. Attention is given to analyzing the phenomenon arising in the redox cell from the interaction of the catholyte ferric ionic flow with the local magnetic field generated by the electric current delivered to the load during discharge. Such interaction will lead to gyromagnetic alignment of the dipolar fluid and the consequent flow of circulating currents, the occurrence of power losses and limitation of output voltage. Results of theoretical and experimental work are discussed in some detail. S. D.

**A79-50362 Applicability of energy model techniques to an analysis of impacts of SO<sub>2</sub> emissions from the U.S. electric utilities and control policies.** R. H. Kim (North Carolina University, Charlotte, N. C.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 516-520. 40 refs.

**A79-50363 Environmental impacts of contemporary fossil energy systems.** H. K. Roffman (Energy Impact Associates, Inc., Pittsburgh, Pa.) In *Learning to use our environment*, Proceedings of the Twenty-fifth Annual Technical Meeting, Seattle, Wash., April 30-May 2, 1979. Mount Prospect, Ill., Institute of Environmental Sciences, 1979, p. 521-530. 32 refs.

A procedure is outlined for assessing the environmental impacts associated with the utilization of coal, oil, and natural gas, noting that the entire fuel cycle must be taken into consideration. It is shown that for these resources three major sequential activities are involved: (1) fuel production, (2) fuel transportation, and (3) power production. The first includes extraction of the resource and its preparation (cleaning, refining, etc.). The second includes all environmental effects associated with the transportation of fuel while the third is concerned with the impacts at the power plant. M. E. P.

**A79-50399 Solar power satellite - Putting it together.** R. W. Johnson (Grumman Aerospace Corp., Bethpage, N. Y.) *IEEE Spectrum*, vol. 16, Sept. 1979, p. 37-40.

The problems of constructing a solar power satellite in earth orbit are surveyed. Consideration is given to such points as the need for an assembly line in space, for lightweight yet strong and durable materials, for a completely new heavy lift launch vehicle and for special manipulative tools for assembly work. Advanced composite materials are discussed as well as the question of whether to build in

low or high earth orbit. Construction techniques described include an automatic beam making machine and remote work stations. Finally, it is concluded that the development of construction techniques for the SPS will have other uses which will reduce the R&D costs chargeable to the solar power satellite. M E P

**A79-50400 Exploiting wave power** B M Count (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England) *IEEE Spectrum*, vol 16, Sept 1979, p 42-49 5 refs

A survey of proposed wave power systems is presented. Five power conversion devices are studied: (1) the Salter Duck - an asymmetric, cam-shaped device, oscillating about a fixed point, (2) the Cockerell Raft - a structure of rafts hinged together, (3) the air buoy - an asymmetric chamber with trapped water and air, (4) the Kamei - a Japanese device resembling an open bottom ship with 22 air chambers, and (5) the rectifier - structure of high level and low level reservoirs. Attention is given to the two basic types of devices: dynamic and passive, and compared. Consideration is also given to such points as transmitting the power to shore, control philosophy for maximum power, and power vs torque. Finally, unsolved problems such as construction of a spine structure strong enough to survive extreme wave conditions are discussed. M E P

**A79-50451 Underground pumped hydro storage - An overview.** S W Tam, C A Blomquist, and G T Kartsounes (Argonne National Laboratory, Argonne, Ill.) *Energy Sources*, vol 4, no 4, 1979, p 329-351 13 refs. Research supported by the US Department of Energy.

This paper reviews the status of underground pumped hydro storage (UPHS) for electric utility peaking and energy-storage applications. The salient features of major recent studies are reviewed. Turbomachinery options and advances in high-head pump/turbines are discussed. The effect of head, capacity, turbomachinery unit size and type, and other performance variables on the cost of a UPHS plant are presented. Market potential, siting criteria, lower reservoir construction, and geologically related issues are addressed. The environmental impact of a UPHS plant is deduced from comparable facilities, and these issues and other safety concerns are presented. UPHS is an economically viable scheme for energy-storage and peaking applications in which considerable savings in premium fuels can be achieved through the replacement of combustion gas turbines. The technology for UPHS is available, but additional research and development are required for high-head turbomachinery, motor/generators, cavern geology, and system optimization. (Author)

**A79-50452 Development of coalbed methane as an energy source.** M L Olson (US Department of Energy, Washington, D C) *Energy Sources*, vol 4, no 4, 1979, p 353-365 12 refs

Development of coalbed methane as the unconventional gas source which could be put into production quickly and cheaply is considered. To promote the development of this potentially large resource, government can initiate a coring program for resource definition, cooperate in clarifying the status of the resource, prescribe the rights of interested parties, and establish incentive programs to speed production and use of coalbed methane. It is estimated that 300 to 800 trillion cu ft of this gas is potentially available and methods of promoting its production are discussed. Legal problems in methane production are considered, noting that they arise primarily in areas where coal rights have been leased and mining operations are underway or planned, and deeper bed mining poses explosion dangers by methane migration into coal mines. Government regulations covering gas ownership and distribution are cited, including regulation and conservation of this resource, and, finally, economics of production and sale are covered. A T

**A79-50460 Testing for commercialization of the central power tower** F Duquette (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) *Solar Engineering Magazine*, vol 4, Sept 1979, p 15, 17

The construction of a central power tower system for a 10 megawatt electrical power plant is examined. Attention is given to the concept development which employs a central receiver system using a large field of heliostats that reflect sunlight to a receiver installed at the top of a steel tower. The design of the receiver utilizes a water/steam single pass to super heat boiler which produces steam as water flows through a panel of 800 tubes and then flows to a storage facility. Consideration is given to the economics of power towers and the factors involved in the acceleration of other power tower constructions. C F W

**A79-50499 # Airport power supply (Elektrosnabzhenie aeroportov)** I S Gladyshev and P L Andreev (Moscow, Izdatel'stvo Transport, 1979) 248 p. In Russian

The book deals with the basic principles and instrumentation of airport power supply. Characteristics of power consumers and techniques for reducing power consumption are discussed. General problems of power supply are considered, including electric network design, methods of design-power selecting, and determining wire and cable cross sections in accordance with heating and voltage-loss requirements. The electric power equipment and relay protection devices for airport transformers and power stations are described along with their design and circuitry. Attention is given to automatics and telemechanics of electric power networks, methods for calculating short-circuit current and selecting power, relay protection, and grounding equipment. The electrotechnic laboratory (ETL-1M) is also described. V T

**A79-50537 Economic evaluation and optimization of solar heating systems.** M J Brandemuehl and W A Beckman (Wisconsin, University, Madison, Wis.) *Solar Energy*, vol 23, no 1, 1979, p 1-10 7 refs.

A procedure is developed for assessing the economic viability of a solar heating system in terms of the life cycle savings of a solar heating system over a conventional heating system. The life cycle savings is expressed in a generalized form by introducing two economic parameters, P1 and P2, which relate all life cycle cost considerations for the first year fuel cost or the initial solar system investment cost. Using the generalized life cycle savings equation, a method is developed for calculating the solar heating system design which maximizes the life cycle savings. A similar method is developed for determining the set of economic conditions at which the optimal solar heating system design is just competitive with the conventional heating system. The results of these optimization methods can be presented in tabular or graphical form. The sensitivity of the economic evaluation and optimization calculations to uncertainties in constituent thermal and economic variables is also investigated. (Author)

**A79-50538 Some thermodynamic considerations on the photodecomposition of water mediated by redox reactions and their relation to solar energy utilization** G Stein and A Zeichner (Jerusalem, Hebrew University, Jerusalem, Israel) *Solar Energy*, vol 23, no 1, 1979, p 11-16 34 refs. Research supported by Boston University and NSF.

**A79-50539 Conceptual development of a solar town in Iran** M N Bahadori (Shiraz University, Shiraz, Iran) *Solar Energy*, vol 23, no 1, 1979, p 17-36 25 refs

A method of solar energy utilization for a residential town of 4000 inhabitants is presented. The energy requirements are estimated without major change in people's life style, except for introduction of low temperature cooking by steam. Four methods of solar energy utilization are considered: (1) central generation of electricity, hot or chilled water and steam (for low temperature cooking), and

distribution to each building, (2) local generation of electricity, hot or chilled water, and steam, and central utilization of city wastes to produce methane gas for high temperature cooking, (3) central utilization of city wastes and plant growth for energy values, and (4) suitable design of buildings to be heated or cooled passively by solar energy and other natural sources, local generation of hot water for washing and steam for low temperature cooking, central generation of electricity, and central utilization of city wastes. It was concluded that the last of these systems is the most suitable, and that the transportation needs are to be met by electricity or liquid fuel, such as methanol, produced from an energy crop. A.T.

**A79-50540 # The steady state salt gradient solar pond.** C F Kooi (Lockheed Research Laboratories, Palo Alto, Calif.) *Solar Energy*, vol 23, no 1, 1979, p 37-45 20 refs. Research supported by the University of Michigan.

The three-zone salt gradient solar pond is analyzed as a steady-state flat-plate solar energy collector. The resultant efficiency equation is of the Hottel-Whillier-Bliss type commonly used for flat-plate collectors. The quantities that occur in this equation - the effective absorptivity-transmissivity product  $\alpha\tau$ , the loss factor  $U(L)$ , the heat removal factor  $F(R)$ , and the incident angle modifier  $\Theta(i)$  - are related to the physical properties and dimensions of the pond. For a given  $\Delta T/H$  (fluid inlet temperature surface temperature/insolation), the thickness of the nonconvective zone can be adjusted for maximum efficiency,  $U(L)$  and  $\alpha\tau$  are smaller than the equivalent quantities for flat-plate collectors, while  $\Theta(i)$  and  $F(R)$  are close to unity. As a consequence, steady-state salt-gradient solar ponds are less efficient than common flat-plate collectors at low  $\Delta T/H$ , but they are more efficient at high  $\Delta T/H$ . (Author)

**A79-50541 Stochastic simulation of hourly global radiation sequences.** C Mustacchi, V Cena, and M Rocchi (Roma, Università, Rome, Italy) *Solar Energy*, vol 23, no 1, 1979, p 47-51 13 refs.

Stochastic simulation of hourly global radiation carried out with auto regressive moving average and factor analysis techniques is found unable to describe the statistical features of time sequences. A Markov transition-matrix approach operating on atmospheric transmittance provides a simple yet effective simulation device. Two novel sophisticated models, the transmittance transition tensor and the Gaussian mapping technique are not justified in this context. (Author)

**A79-50542 Static concentrators for two-sided photovoltaic solar cells.** J Sangrador and G Sala (Madrid, Universidad Politécnica, Madrid, Spain) *Solar Energy*, vol 23, no 1, 1979, p 53-60 5 refs.

The use of cylindrical mirrors to concentrate radiant energy onto a two-sided photovoltaic absorber has been studied. Both theoretical and experimental results for the illumination intensity at the exit aperture were obtained for such a concentrator. A mathematical approach was devised to obtain the theoretical intensity distribution. Experimental intensity distribution was measured for a set of different mirrors. The mirrors all had the same profile but were made of different materials and had different reflecting surfaces. The main conclusion was that the intensity distribution at the exit aperture is very inhomogeneous. The concentration was very low (less than 3) for a certain zone of the absorber, regardless of the light rays incidence angle. Another important conclusion was the effect of truncating the mirror, which was found to be a reduction in the average number of reflections of the incident light. Finally, an arrangement, different from the theoretical one, is presented for the placement of the absorber in the concentrator. (Author)

**A79-50543 Contribution to the study of the solar radiation climate of Lisbon.** A J Biga and R Rosa (Ministerio da

Industria e Tecnologia, Laboratorio de Fisica e Engenharia Nucleares, Sacavém, Portugal) *Solar Energy*, vol 23, no 1, 1979, p 61-67 9 refs.

Based upon a statistical analysis of available data, this paper offers relationships permitting the determination of the direct, diffuse and global radiation intensities, on a horizontal surface and on clear days, and it establishes linear correlation between those three components. Daily sums of diffuse and global radiation, on a horizontal surface and on cloudy days, are found to be correlated with one another and they both can be determined from the knowledge of the insolation fraction. This paper also analyzes the contribution of the direct and diffuse components to the daily sum of global radiation on the ground, with emphasis to the contribution of diffuse radiation from the cloudy regions of the sky, and infers some global characteristics of the clouds. Finally, it is shown that four regression parameters alone are enough to make fair predictions of all the statistical relationships involving daily sums of solar radiation. (Author)

**A79-50544 Performance of flat plate solar collector with fluid undergoing phase change.** R S Soin, K S Rao, D P Rao, and K S Rao (Birla Institute of Technology and Science, Pilani, India) *Solar Energy*, vol 23, no 1, 1979, p 69-73. Research supported by the Ministry of Industrial Development of India and Birla Institute of Technology and Science.

The experimental set up for evaluating the performance of a solar collector with a fluid undergoing phase change is described. The effect of insolation and the liquid level on the collector performance has been studied with acetone and petroleum ether 40-60 C. The Hottel-Whillier equation, when modified to include the fraction of liquid level, correlates the experimental data. The collector efficiency increases linearly with liquid level. (Author)

**A79-50545 Chemical heat pumps - A basic thermodynamic analysis.** W M Ralston and W E Wentworth (Houston, University, Houston, Tex.) *Solar Energy*, vol 23, no 1, 1979, p 75-79 20 refs. Research supported by Styrelsen for Teknisk Udvikling and University of Houston, Contract No N68305-77-C-0043.

The concept of a thermochemically driven chemical heat pump/refrigerator is discussed. Using Carnot analysis, it is shown that these systems can work closely to the maximal second-law efficiency. Criteria to be used in selection of chemical reactions for maximal efficiency are formulated. (Author)

**A79-50546 A comparison of some simple models used to predict solar irradiance on a horizontal surface.** B Goldberg, W H Klein, and R D McCartney (Smithsonian Institution Radiation Biology Laboratory, Rockville, Md.) *Solar Energy*, vol 23, no 1, 1979, p 81-83 8 refs.

**A79-50547 New ideal concentrators for distant radiation sources.** D R Mills and J E Giutronich (New South Wales, University, Kensington, Australia) *Solar Energy*, vol 23, no 1, 1979, p 85-87 9 refs.

The construction of an ideal two dimensional linear concentrator is examined for a convex cylindrical receiver using the general constraint that all rays from the extreme directions of the acceptance angle are reflected tangentially to the receiver surface. The development of an additional family of both ideal and nearly ideal concentrators for distant point sources of radiation is presented and a specific case with applications in solar thermal collection is investigated. This special case can be generally applied when the Winston-Hinterberger (1975) curve section is eliminated on one side of the concentrator, and the other surface is extended to meet the shadow line which prevents the rays coming from an outside point from directly striking the adsorber. C F W

**A79-50548** Fabrication of spectrally selective surfaces by thermal treatment of austenitic stainless steel AISI 321 V C Sharma (Benin, University, Benin City, Nigeria) and M G Hutchins (University College, Cardiff, Wales) *Solar Energy*, vol 23, no 1, 1979, p 89, 90. Research supported by the Science Research Council

**A79-50549** Solar conversion by concentration cells with hydrides. R E Salomon (Temple University, Philadelphia, Pa.) *Solar Energy*, vol 23, no 1, 1979, p 91, 92 Contract No ET-78-S-05-5669

The conversion of solar heat into electrical energy by concentration cells with hydrides is discussed. The optimum situation is considered in which all of the heat is used to vaporize a certain amount of hydrogen. The process is carried out at either fixed volume or fixed pressure. The efficiency of using electrochemical concentration cells is discussed. The absence of moving parts is considered as an advantage. It is noted that the electrical resistance of the cell is an important parameter which must be taken into account during the initial stage of evaluation. V T

**A79-50557** Electrochemical energy storage systems - A small scale application to isolated communities in the Canadian Arctic. W A Adams, C L Gardner, and E J Casey (Defence Research Establishment, Energy Conversion Div., Ottawa, Canada) *Canadian Electrical Engineering Journal*, vol 4, July 1979, p 4-10 17 refs

The paper examines the potential economic and energy savings that could result from inclusion of energy storage devices into the power generation system in northern Canadian communities. The discussion is confined to an analysis of the potential benefits of incorporating energy storage systems into the utility systems of eight northern Canadian communities. Major conclusions are that fuel savings are possible, that cost benefits are achievable depending on the specific mix of cost parameters especially in high fuel cost locations, and that research and development now under way to improve the cost and performance of batteries for load leveling will make such systems more attractive as an energy conservation tool. S D

**A79-50560** Biomethanation of Minnesota reed sedge peat. S Ghosh and D L Klass (Institute of Gas Technology, Chicago, Ill.) *Resource Recovery and Conservation*, vol 4, Aug 1979, p 115-139 8 refs

A method to develop a bioconversion system for the production of intermediate or high calorific value gas, from Minnesota reed sedge peat, is examined. The experimental work consisted of four parts: feed characterization, exploratory batch, digestion experiments, semicontinuous digestion of peat alone, and investigations of conditions for improved peat digestion. The effects of such factors as digestion mode, inoculum source, temperature, loading detention time, feed particle size, and chemical pretreatment on peat digester gas yield, production rate, and gas quality, were examined. It was determined that a methane yield of up to 0.31 std cu m/kg VS added, which is approximately 60% of the maximum theoretical yield, can be obtained by optimizing the digestion and feed pretreatment conditions. C F W

**A79-50561** The efficiency of resource recovery from solid waste. D C Wilson (Atomic Energy Research Establishment, Harwell, Oxon, England) *Resource Recovery and Conservation*, vol 4, Aug 1979, p 161-188 28 refs. Research supported by the U K Atomic Energy Authority

The possible advantages that resource recovery from waste has to the conservation of energy and materials is examined. Two self-consistent measures of the energy efficiency of a process are developed and a method using the same case study as in complementary economic analysis is demonstrated. Process energy analysis

is applied to evaluate both the primary energy inputs to an option for waste disposal, treatment or resource recovery, and the savings implied by the use of recovered fuel and material products. Attention is given to the accidental waste-to-oil pyrolysis system and the data regarding its efficiency as well as that of waste-derived and refuse-derived fuel are tabulated. Results show that conventional methods of local landfill are cheap and wasteful, that pulverized fuel is feasible as a fuel source and that other methods of producing a solid refuse derived fuel have the highest energy efficiency values. C F W

**A79-50563** The 'effectiveness' of waste treatment systems. B G Kreiter (Institute for Waste Disposal, Amersfoort, Netherlands) *Resource Recovery and Conservation*, vol 4, Aug 1979, p 203-207

The possibility of implementing an overall 'effectiveness-value' composed of parameters of volume reduction, energy production or savings, and treatment costs, is examined. An example is made by comparing separated domestic waste where the light fraction is used as a supplementary fuel for utility plants and municipal solid waste, which is incinerated and the resultant heat (from the plant) is employed to generate heat. C F W

**A79-50700** Solar photoconverters based on Zn(x)Cd(1-x)S solid solutions. L D Budennara, P P Gorbik, V N Komashchenko, G A Fedorus, and E V Sharkina (Akademiya Nauk Ukrainsoi SSR, Institut Poluprovodnikov, Kiev, Ukrainian SSR) (*Geliotekhnika*, no 1, 1979, p 3-5) *Applied Solar Energy*, vol 15, no 1, 1979, p 1-3 Translation

Polycrystalline thin films of Zn(x)Cd(1-x)S were produced and used to prepare pCu2S-nZn(x)Cd(1-x)S heterojunction solar cells. The optimal concentration for construction of solar cells is found to be Zn(0.1-0.2)Cd(0.9-0.8)S. The photo-emf of the heterostructure of optimal composition attains a value of 0.8 V. The short-circuit current (and therefore the efficiency) of the heterostructure is limited mainly by a large series resistance. B J

**A79-50701** Temperature characteristics of high-voltage germanium photogenerators. D S Strebkov, V A Tikhomirova, and G B Fedosova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 1, 1979, p 6-9) *Applied Solar Energy*, vol 15, no 1, 1979, p 4-6 Translation

The paper reports on the volt-ampere characteristics of high-voltage germanium photoconverters in the -50 to +100 C temperature range as well as on the temperature dependence of the principal parameters of the device. It is suggested that such photoconverters can be used as high-voltage dc converters, as IR detectors, and in conjunction with silicon photoconverters. B J

**A79-50702** Analysis of series resistance of pCdTe-nCdS film photoconverters. S A Azimov, Sh A Mirsagatov, D T Rasulov, and N Shakirov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 1, 1979, p 10-12) *Applied Solar Energy*, vol 15, no 1, 1979, p 7-9 6 refs Translation

**A79-50703** Spectral emissivity of porous graphite heated in an air atmosphere. N A Rubtsov, A G Tarasov, and G V Miakin (Akademiya Nauk SSSR, Institut Teplofiziki, Novosibirsk, USSR) (*Geliotekhnika*, no 1, 1979, p 13-16) *Applied Solar Energy*, vol 15, no 1, 1979, p 10-12 Translation

An optical facility for measuring spectral emissivity is described. The system is applied to measuring the emissivity of PG-50 graphite heated in air, taking into account the character of the emitting surface and wavelength and temperature. An inverse relationship between wavelength and spectral emissivity is shown. B J

**A79-50704** Optimal geometric parameters of cavity solar collectors with selective radiation-absorption properties. R. A. Zakhidov, A. Abdurakhmanov, and Sh. I. Klychev (Akademii Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) (*Geliotekhnika*, no. 1, 1979, p. 17-20) *Applied Solar Energy*, vol. 15, no. 1, 1979, p. 13-15 Translation

**A79-50705** Combination radiant-flux radiator for high-temperature solar plant V. V. Afian and A. V. Vartanian (*Geliotekhnika*, no. 1, 1979, p. 21-24) *Applied Solar Energy*, vol. 15, no. 1, 1979, p. 16-18 Translation

The paper describes a radiant-flux controller for a high-temperature solar collector system with paraboloidal concentrator, block and kinematic diagrams are presented. The controller consists of two screening cylinders (external and internal) in simultaneous operation. The device controls two parameters: radiant flux density in the focus and collected power. An experimental controller has been tested. B. J.

**A79-50706** Accelerated investigation of the light resistance of shaped polyethylene tubes and sheets under natural climatic conditions. V. N. Volkov, Ia. T. Shermazanian, N. V. Shilko, A. G. Sinakarimian, and T. A. Nersisian (*Geliotekhnika*, no. 1, 1979, p. 39-42) *Applied Solar Energy*, vol. 15, no. 1, 1979, p. 31-34. 8 refs Translation.

Profiled polyethylene sleeves and sheets were subjected to accelerated testing in a solar-radiation facility. Polyethylene stabilized with soot additive was found to have the highest radiation resistance, color-tinted polyethylene was found to have the least. It is recommended that the soot-stabilized variety be used outdoors while the color-tinted variety be used indoors (under conditions of scattered solar radiation). B. J.

**A79-50707** Investigation into the optical characteristics of transparent solar-energy materials. N. B. Rekant and S. A. Demidov (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 1, 1979, p. 46-49) *Applied Solar Energy*, vol. 15, no. 1, 1979, p. 38-40 Translation

A simple method is developed for measuring the absorptivity and transmissivity of thin polymeric films at room temperature. The chief characteristic of the materials tested is their semitransparency (during interaction with thermal radiation) in a wide spectral range, from the UV to the far IR. B. J.

**A79-50708** Analysis of the efficiency of a varizone photoelectric converter. L. I. Gromovoi, L. I. Tikhonov, and V. N. Diatlov (*Geliotekhnika*, no. 1, 1979, p. 57-62) *Applied Solar Energy*, vol. 15, no. 1, 1979, p. 47-51. 8 refs Translation

The volt-ampere characteristics and the photocurrent under solar illumination of a variable-band semiconductor structure are calculated. Consideration is then given to the efficiency of a variable-band  $\text{pAl}(x)\text{Ga}(1-x)\text{As-nGaAs}$  solar cell and the efficiency of this type of cell is compared to that of a homogeneous GaAs solar cell. Particular attention is given to the case when the variable-band region can be represented as a 'direct' semiconductor (i.e.,  $x$  is not greater than 0.4). B. J.

**A79-50775** Calculation of the external electromagnetic field of closely spaced MHD machines. S. M. Apollonskii (*Magnitnaia Gidrodinamika*, Oct-Dec 1978, p. 88-92) *Magnetohydrodynamics*, vol. 14, no. 4, Apr. 1979, p. 463-466. 5 refs Translation.

A method is proposed for calculating the combined electromagnetic field of MHD machines located close to each other, by means

of correction factors. Correction factors with respect to harmonics are obtained for calculating the combined field of two MHD sources. Illustrative calculations are presented and the results are compared with the experiment. V. P.

**A79-50776** Theoretical and calculational investigation of MHD machines with two-layer windings and half-filled slots around the edges of the inductor. A. I. Vol'dek, N. A. Soldatenkova, and E. V. Tolvinskaya (*Magnitnaia Gidrodinamika*, Oct-Dec 1978, p. 101-106) *Magnetohydrodynamics*, vol. 14, no. 4, Apr. 1979, p. 474-479 Translation

**A79-50777** Two limiting solutions for the analysis of transverse edge effects in MHD induction machines. A. P. Rashchepkin. (*Magnitnaia Gidrodinamika*, Oct-Dec 1978, p. 107-111) *Magnetohydrodynamics*, vol. 14, no. 4, Apr. 1979, p. 479-482. 5 refs Translation

A comparison is made of the energetic characteristics of an induction machine, calculated on the basis of Okhremenko's (1968) and Veske's (1965) models. It is found that the energetic characteristics differ under conditions of a pronounced transverse edge effect, if the channel width is smaller than or equal to the pole pitch. The results of the two models are practically identical under any conditions, if the gap is smaller and the channel width is larger than twice the pole pitch value. V. P.

**A79-50778** Limit of the formation of counterparallel flows in plane-parallel induction MHD machines. R. R. Krishberg (*Magnitnaia Gidrodinamika*, Oct-Dec 1978, p. 112-116) *Magnetohydrodynamics*, vol. 14, no. 4, Apr. 1979, p. 483-486. 10 refs Translation

In high-power MHD machines, counterflows may arise at large magnetic Reynolds numbers, due to the demagnetizing action of secondary currents. In the present paper, the limits of formation secondary flows over the channel width are analyzed. It is shown experimentally that low-power pumps can be used to study such counterflows. In this case, high magnetic Reynolds numbers can be achieved by increasing the frequency. V. P.

**A79-50779** Equations of a conduction-type MHD linkage. Iu. A. Birzvalk. (*Magnitnaia Gidrodinamika*, Oct-Dec 1978, p. 130-134) *Magnetohydrodynamics*, vol. 14, no. 4, Apr. 1979, p. 498-502. 10 refs Translation

In the present paper, the linear equations of a classical conduction MHD ejector are obtained in an inductionless approximation, and are found to be analogous to those of an electric two-port network. The conditions for maximum efficiency are derived as a function of the output hydromechanical resistance. A relation for the optimal induction is obtained. The attainable efficiency values are identified, using a numerical example. V. P.

**A79-50855 #** Towards an adequate legal regulation of the geostationary orbit. A. A. Cocca. In: Colloquium on the Law of Outer Space, 20th, Prague, Czechoslovakia, September 25-October 1, 1977, Proceedings. Davis, Calif., University of California, Littleton, Colo., Fred B. Rothman and Co., 1978, p. 193-196.

Some notes on giving the geostationary orbit an appropriate juridical regime are presented. It is remarked that it is necessary to study the geostationary orbit from the following points of view: as a region in space; as a site for placement of satellites, as a point of reception and emission of telecommunications, as an area of interception and transmission of solar energy, in terms of a right to follow a route or a regime of routes of flight, as a limited natural resource; and as reference for possible delimitation of outer space.

B. J.

**A79-50860 # Legal considerations on the development and use of satellite solar power stations** R H Moss In Colloquium on the Law of Outer Space, 20th, Prague, Czechoslovakia, September 25-October 1, 1977, Proceedings Davis, Calif, University of California, Littleton, Colo, Fred B Rothman and Co, 1978, p 374-385 82 refs

The paper summarizes a proposal for satellite solar power stations, outlines the technical system, and examines the legal controls that may affect exploitation of solar energy for terrestrial use by large satellites in geosynchronous orbit. The role of the lawyer is discussed, and it is urged that the lawyer engage in public advocacy with regard to SSPS development B J

**A79-50876 Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings.** Conference sponsored by the American Nuclear Society. Edited by A E Saint Clair (Oak Ridge National Laboratory, Oak Ridge, Tenn) La Grange Park, Ill, American Nuclear Society, 1978 628 p \$38

The conference presents papers on such topics as solar energy, coal conversion, biomass and waste conversion, oil shale, indirect solar energy, energy storage and hydroelectric, and geothermal energy. A review of the environmental effects and benefits of solar technologies and siting considerations for solar thermal electric generating plants are given. Environmental investigations of in situ coal classification experiments and environmental aspects of the DOE's underground coal conversion program are discussed. Environmental aspects of wood fuel are outlined along with social, economic, and legal implications of bioenergy and primary impacts of growing aquatic plants for energy. Emphasis is placed on geyser geothermal operations and other geothermal energy resources and their environmental aspects V T

**A79-50877 Resolving the environmental issues in developing fuels from biomass.** J E Dunwoody (Mittelhauser Corp, Lisle, Ill) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 3-3 to 3-14 15 refs

This paper reviews recent studies on the potential for environmental impact by biomass energy technologies and outlines a framework for a national program of biomass energy environmental research. Although there has been considerable research on environmental impacts of intensive agriculture, silviculture and urban waste energy technology most of this information has not yet been applied to biomass energy technologies. The need for a substantial biomass energy environmental research program spanning the next 3-5 years is emphasized to prevent environmental concerns from inhibiting the commercial application of biomass energy technologies (Author)

**A79-50878 A review of the environmental effects and benefits of selected solar energy technologies** K A Lawrence (Solar Energy Research Institute, Golden, Colo) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 4-3 to 4-16 30 refs

The paper reviews and summarizes data on the environmental effects of three solar energy technologies: photovoltaic cells, wind energy conversion (WEC), and solar thermal central receivers. Potential effects are identified for each of the life cycle phases: resource extraction and component manufacture, plant construction, and operation and decommission. The life cycle phase of resource extraction and component production is found to be the most environmentally hazardous. None of the options emit sulfur oxides, nitrogen oxides, particulates, hydrocarbons, or carbon monoxide. WEC operations produce low-level noise pollution and present hazards to flying species. Solar thermal facilities may affect local air quality via wet cooling towers V T

**A79-50879 Siting considerations for solar thermal electric generating plants.** E J McBride (Black and Veatch, Kansas City, Mo) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 5-3 to 5-7

The paper discusses the siting considerations for a central receiver plant in which a field of two-axis tracking mirrors redirects and concentrates the solar radiation to the receiver(s) which is (are) located at the top of a centrally located tower. The siting considerations for this type of plant are similar in many aspects to those for fossil and nuclear plants. Those of most importance are insolation, meteorology, topology, and hydrology. While these limit the best land areas to a small fraction of the available land, there are nonetheless more suitable sites than will be necessary for this energy source to be commercialized to its cost effective limit in the foreseeable future V T

**A79-50880 Environmental investigations of in situ coal gasification experiments** S W Mead, F T Wang, and H C Ganow (California, University, Livermore, Calif.) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 14-3 to 14-18 10 refs

Research supported by the U.S. Environmental Protection Agency, Contract No. W-74595-eng-48.

Ground-water sampling and subsidence measurements were carried out at the sites of two in situ coal gasification experiments conducted in northeastern Wyoming. Changes in ground-water quality and the possible effects of subsidence and ground movement induced by the gasification cavity represent environmental concerns associated with the in situ coal gasification process. Ground-water quality measurements show a continuing decrease, after more than a year, in the concentration of important contaminants, such as phenolic materials. Laboratory measurements have provided detailed information concerning phenol absorption by coal. Data from subsurface geotechnical instruments as well as measurements of ground-water levels indicate that roof collapse connected the gasification cavity with overlying aquifers V.T.

**A79-50881 Mixed fuel gas - A technically, economically and environmentally superior way to supplement natural gas supplies** J E Sinor (Cameron Engineers, Inc, Denver, Colo) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 15-3 to 15-10

An approach to coal conversion is discussed in which approximately 85 volume % low-Btu gas is mixed with 15 volume % natural gas to produce a 300 Btu/SCF mixture called mixed fuel gas (MFG). The Btu percentage from each source will be approximately 50/50. A value of 300 Btu/SCF was chosen because combustion efficiency is maximum at this point. MFG could be burned in existing gas-fired boilers without incurring the large loss in both efficiency and capacity that may result from burning low Btu gas alone. It can be produced at less cost and with less total environmental impact than either medium-Btu or high-Btu coal gas V T

**A79-50882 Environmental aspects of the Department of Energy's underground coal conversion program.** S H Zukor and E L Burwell (U.S. Department of Energy, Washington, D.C.) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 16-3 to 16-20 20 refs

The Department of Energy's Underground Coal Conversion Program is described, with emphasis on environmental activities. The basic underground coal gasification (UCG) process is explained, along with potential advantages and problem areas. Results to date indicate

that the environmental impacts of UCG will be minimal and well within the capability of current environmental control technology. When compared to alternate uses of coal, UCG may offer significant environmental advantages, especially in areas of the country where high-quality water is in short supply (Author)

**A79-50883 Air emissions from waste to energy systems.**

H M Freeman and R A Olexsey (U S Environmental Protection Agency, Cincinnati, Ohio) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 18-3 to 18-13

This paper discusses expected air emissions from waste to energy conversion systems. It provides an overview of waste to energy conversion technology, a discussion of relevant Federal environmental standards, and a compilation of the results of environmental assessments of three systems, (1) an RDF combustion system at Ames, IA, (2) a mass burning waterwall incinerator at Braintree, MA, and (3) a partial oxidation pyrolysis unit at South Charleston, WV. Data is provided for Criteria Pollutants and for various trace elements (Author)

**A79-50884 Environmental aspects of wood fuel.**

H T Garabedian and C R Sanborn (Vermont Agency of Environmental Conservation, Montpelier, Vt) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 19-3 to 19-21 9 refs

An analysis of whole tree harvesting for wood fuel and the conversion of existing electric generating stations to consume wood fuel is presented. Consideration is given to planning an experimental harvest, preharvesting inventory, wood operation, environmental impacts of the harvesting operation, and the economics of wood fuel. It is noted that whole tree removal resulted in 3 - 4.5 times the yield expected by traditional inventory methods. Wood fuel is low in heating value, high in moisture, and has undesirable handling characteristics, however, the contents of sulfur and nitrogen are low. Emission testing has determined that the particulate emission rate from a mix of 45% oil/55% coal increased threefold as compared with 80% wood/20% oil (V T)

**A79-50885 Some environmental impacts of resource recovery systems.**

W H Fisher (Gilbert/Commonwealth, Reading, Pa) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 20-3 to 20-14 25 refs U S Environmental Protection Agency Contract No 68-03-2645

The interactions of combining source separation and mixed waste processing are evaluated in terms of their environmental impacts on land, air, and water. The mixed waste processing options considered are waterwall incinerators, small incinerators (refractory-lined dual-chamber incinerators of less than 100 tpd capacity), refuse-derived fuel (RDF) used either as a supplement to fossil fuels or alone in a dedicated boiler, pyrolysis of the wastes to a gas or an oil, and the Black Clawson hydropulper process for making RDF. Ferrous wastes were assumed to be recovered in all the options except small incinerators. Land impacts are much reduced as compared with direct landfilling. Air impacts can be controlled with presently available technologies. Water impacts may be large, and effluents from some waste processing plants may require advanced treatment before discharge. Source separations have little influence on these impacts (V T)

**A79-50886 Primary impacts of growing aquatic plants for energy.**

T Hruby (Woods Hole Oceanographic Institution, Woods Hole, Mass) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 22-1 to 22-16 17 refs Research

supported by the Pew Memorial Trust and Woods Hole Oceanographic Institution, Grant No NOAA-04 7 158-44104

The environmental impacts of systems proposed for the large scale culture of algae or other aquatic plants on the open ocean in shallow coastal waters, or in ponds on land are considered. All systems are found to be potentially dangerous for the natural and human environments, but those for the land-based farms are more dependent on the exact design of the ponds and their processing units than either the open-ocean or near shore systems. Therefore if environmental impacts are used as criteria in the choice of a system, aquatic plants grown in ponds are better suited for development as biomass sources than those cultured on the open ocean or near the shore (V T)

**A79-50887 The status of oil shale development.**

J D Baker (Cameron Engineers, Inc, Denver, Colo) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 23-3 to 23-10

Four basic approaches for exploiting an oil shale deposit are considered: (1) open pit mining and surface retorting, (2) underground mining and surface retorting, (3) modified in situ recovery, and (4) true in situ recovery. Environmental problems, such as health effects, air quality, water quality and availability, and land disturbance, are discussed. Seven commercial oil shale projects in Colorado and Utah are outlined. Emphasis is placed on the role of oil shale in the national energy plan. It is noted that the increasing probability of severe shortages of liquid fuels between now and the end of the century has cast oil shale in a more prominent role in Federal energy policy than ever before (V T)

**A79-50888 Chemical characterization of shale oil and related fuels.**

P W Jones, R J Jakobsen, P E Strup, and A P Graffeo (Battelle Columbus Laboratories, Columbus, Ohio) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 26-29 to 26-35

Results of a preliminary analytical survey of the organic constituents of shale oil, synthoil, and Prudhoe Bay crude oil are presented. The analytical techniques employed in the study are liquid chromatography (LC), Fourier transform infrared spectroscopy (FTIR), and gas chromatographic mass spectrometry (GC-MS). This chemical characterization of new fuels provides preliminary data from which their potential environmental impacts may be judged (V T)

**A79-50889 Environmental aspects of the Syncrude tar sands project.**

N A Norman and N A Norman (Bechtel National, Inc, San Francisco, Calif) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo, September 26-29, 1978, Proceedings La Grange Park, Ill, American Nuclear Society, 1978, p 27-3 to 27-9 5 refs

The oil in the Canadian Tar Sands is in the form of bitumen mixed into sand near the land surface. The recovery of the sand is accomplished through an open-pit mining operation using four 80-cubic yard bucket drag-line excavators. A primary feature of the Syncrude tar sand project is the avoidance and mitigation of environmental impacts through facility design, extensive monitoring, and reclamation, including a field developed program of revegetation. Environmental impacts and mitigation of mining and refining phases are discussed. The majority of the impacts associated with the pipeline to Edmonton were a result of the construction operation and were mitigated or reclaimed after the pipeline was laid (V T)

**A79-50890 Projected impacts of a very large windpower complex.**

W E Howell In Conference on Environmental Aspects of



Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 29-3 to 29-18 19 refs

The combination of large windfarms dispersed along the northeastern coasts of North America and over the Laurentian and Appalachian highlands with a pumped-hydroelectric plant near Niagara, and transmission lines linking these elements with major load centers of the Boston/Washington and Chicago/Pittsburgh megalopolises, is taken as the image of large-scale use of the windpower technology now approaching commercialization. A thought-experiment is performed to examine the environmental impacts of building such a large-scale windpower complex. It is concluded that large-scale windpower would involve no adverse environmental effects and could offset serious unfavorable impacts of conventional power generation. There may be a role for centralized and dispersed power systems evolving symbiotically. S D

**A79-50891 Wave power, progress and prospects.** B M Count (Central Electricity Generating Board, Marchwood Engineering Laboratories, Marchwood, England). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 31-3 to 31-33 12 refs

The environmental acceptability of wave power has been one of the major arguments for proposing it as an alternative source of energy to both nuclear and fossil fuels. From the work described in the present paper, it appears that the deployment of wave power could have a varied impact on the environment. Some of the effects may be beneficiary, some adverse, and to argue the case for wave energy on environmental issues alone would certainly be unjustified and misleading. Many of the arguments presented depend crucially on the technical solutions that are likely to be employed. Certain effects, particularly littoral drift, will be device specific, with seabed fixed structures altering the wave climate more than floating ones. Expensive research work is required in view of the formidable technological problems which still exist. V.P.

**A79-50892 Technology overview of energy storage systems.** C M Buoni (Battelle Columbus Laboratories, Columbus, Ohio) and J Gahmer (U.S. Department of Energy, Div of Energy Storage, Washington, D.C.). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 32-3 to 32-37

A state-of-the-art review of energy storage technologies is presented. A discussion of thermal energy storage covers seasonal storage for heating and cooling, daily heating and cooling storage, storage for thermal power generation, and industrial waste heat generation. Thermochemical energy storage involves a discussion of thermochemical pipelines, yearly averaging storage and a chemical heat pump storage system. Attention is also given to hydrogen energy storage with four areas addressed, production, storage, transport, and utilization. In addition mechanical, magnetic and electrochemical energy storage systems are surveyed. Among the conclusions it is expected that by 1990 a number of energy storage technologies will be available for commercial use. M E P

**A79-50893 Environmental considerations in R&D planning and evaluation of energy storage systems.** L Holt (U.S. Department of Energy, Div of Energy Storage Systems, Washington, D.C.). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 33-3 to 33-25

The National Environmental Policy Act (NEPA) of 1969 established a requirement for performing environmental assessments of developed programs and activities. In compliance with NEPA, the Division of Energy Storage Systems (STOR) of the Department of

Energy has instituted an ongoing program to establish and maintain an Environmental Development Plan (EDP). Each STOR program is reviewed annually to ensure that the program considers environmental issues. If a program has potential for environmental impacts the concerns and benefits are analyzed. Environmental concerns are ranked in order of importance so that those which produce the greatest environmental effects can be assessed relative to their benefits in early stages of the program. R&D program development and the resulting environmental interactions are continuously assessed during each phase of the program. Integrations of an environmental development program with the energy technology R&D program results in economically feasible, socially acceptable, and environmentally safe energy storage technologies. (Author)

**A79-50894 Pumped storage projects and their environmental impacts - An overview.** J. K. Novak and D. L. Shumway (U.S. Department of Energy, Federal Energy Regulatory Commission, Washington, D.C.). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 34-3 to 34-19 28 refs

Environmental impacts associated with construction activities and project operations of pumped storage projects are surveyed. Early awareness of the environmental consequences of pumped storage projects by developers and the involvement of natural resource personnel in the planning phase can serve to minimize the impact of these projects on the aquatic, terrestrial, and human resources of the area. B.J.

**A79-50895 Environmental concerns related to compressed air energy storage.** J. A. Stottlemire, R. A. Craig, W. V. Loscutoff (Battelle Pacific Northwest Laboratories, Richland, Wash.), D. W. Boehm (U.S. Department of Energy, Div of Environmental Control Technology, Washington, D.C.), and G. C. Chang (U.S. Department of Energy, Div of Energy Storage Systems, Washington, D.C.). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 35-3 to 35-9 Contract No. EY-76-C-06-1830

The paper briefly describes the technologies of compressed air energy storage (CAES) and notes the environmental factors which may be of concern in the implementation of these technologies. No attempt is made to quantify these environmental factors. In CAES, the compression and combustion phases of operation of the gas- or oil-fired turbine are separated. The environmental concerns are discussed relative to air impacts, water impacts, solid waste, impacts on geological structure, impacts due to noise, impacts on esthetic values and land use, and commitment of valuable resources. Also described is an ongoing research program designed to evaluate methods to control the effects of these environmental factors. S D

**A79-50896 Environmental aspects of geysers geothermal operations.** C. J. Weinberg (Pacific Gas and Electric Co., San Ramon, Calif.). In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 38-3 to 38-22 30 refs

The Geysers Geothermal Project (GGP) is located in a remote area of northern California, approximately 90 miles north of San Francisco. Many of the environmental concerns which have focused on the GGP are due to lack of information rather than actual observed effects. Essentially, many environmental concerns are a direct result of the constituents of geothermal fluids. The paper focuses primarily on the vapor-dominated geothermal resource existing at the GGP. The discussion covers analysis of geothermal fluids, air quality, H<sub>2</sub>S abatement, cooling tower drift, water quality and fisheries, vegetation mapping and land use, wildlife studies, noise sources and levels, and geology, seismicity and subsidence. At present, the predominant problem is H<sub>2</sub>S emission. S D.

**A79-50897** The consumptive use of water in geothermal energy applications. J F Kunze (Forsgren, Perkins, and Associates, Rexburg, Idaho) and S G Spencer (EG&G Idaho, Inc., Idaho Falls, Idaho) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p 39-3 to 39-8

Water is the prime environmental concern for the future development of geothermal resources in the United States. The central questions concern the use of water, injection, and effects on conventional water supplies. The annual regional water requirements for projected geothermal developments in the year 2000 could consume in excess of  $1.8 \times 10$  to the 6th acre-ft/yr ( $2.2 \times 10$  to the 9th cu m/yr). Alternative cooling methods which consume little or no water are available and should be considered for future geothermal developments. (Author)

**A79-50898** Environmental considerations and the geothermal energy resource in Louisiana. R E Emmer (Coastal Environments, Inc., Baton Rouge, La.) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p. 40-3 to 40-27. 18 refs.

A new source of energy from the geopressure-geothermal zone is currently being evaluated in southern Louisiana. The paper is concerned with the environmental impacts of the resource definition program for the short term and the utilization of the resource for the long term. Planning is the common denominator which connects the short-term objectives of defining the resource and the long-term objectives of using the resource. Planning is undertaken for efficient and economic resource exploitation with a minimum of delay caused by unwise decisions. Research indicates that the Pleistocene Terraces of southern Louisiana rather than the coastal wetlands afford the more compatible setting for absorbing direct adverse impact resulting from the resource exploration phase of the geopressure program and for accommodating secondary development stimulated by resource exploitation. S.D.

**A79-50899 \*** Environmental assessment of the proposed nonelectric application of geothermal resources at Desert Hot Springs, California. L Rosenberg (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p 41-3 to 41-18. 12 refs. Research sponsored by the California Energy Commission and U.S. Department of Energy.

The paper presents an environmental analysis performed in evaluating various proposed geothermal demonstration projects at Desert Hot Springs. These are categorized in two ways: (1) indirect, or (2) direct uses. Among the former are greenhouses, industrial complexes, and car washes. The latter include aquaculture, a cascaded agribusiness system, and a mobile home park. Major categories of environmental impact covered are: (1) site, (2) construction of projects, and (3) the use of the geothermal source. Attention is also given to the disposal of the geothermal fluid after use. Finally, it is concluded that there are no major problems foreseen for each project, and future objectives are discussed. M.E.P.

**A79-50900** Environmental considerations of the development of geothermal power plants which utilize liquid-dominated resources - The Heber project. T E Perry (San Diego Gas and Electric Co., San Diego, Calif.) In Conference on Environmental Aspects of Non-Conventional Energy Resources - II, Denver, Colo., September 26-29, 1978, Proceedings. La Grange Park, Ill., American Nuclear Society, 1978, p 44-3 to 44-19.

The potential environmental effects of developing a liquid dominated reservoir at Heber, California are addressed. The facility will utilize a binary cycle power conversion system and generate 65

megawatts of electric power. Attention is given to environmental considerations unique to such a power plant such as geothermal brine (sludge) waste disposal and cooling tower drift. Areas covered in the discussion of environmental considerations are geology, hydrology, biology, air resources, noise, and land use. Finally consideration is also given to socioeconomic and cultural resources, and a trade-off analysis matrix is presented. M E P

**A79-50909** Solar photovoltaic energy. H Ehrenreich and J. H. Martin (Harvard University, Cambridge, Mass.) *Physics Today*, vol. 32, Sept. 1979, p. 25-32.

The paper describes the solar photovoltaic energy study of the American Physical Society. The study examined general systems questions, solar cell technologies, cost goals, and directions for future research. B J

**A79-50913** Char gasification. I - Transport model. G A Simons (Physical Sciences, Inc., Woburn, Mass.) *Combustion Science and Technology*, vol. 20, no 3-4, 1979, p 107-116. 14 refs. Contract No. E(04-3)-1234.

A general model is developed to describe the mass transport and heterogeneous chemistry which occurs during the gasification of porous coal char. The pore branching sequence depicts that each pore that reaches the exterior surface of the particle is the trunk of a tree. The gasification rate per pore tree is obtained analytically. The effects of Knudsen diffusion, continuum diffusion, and both adsorption and desorption kinetics are included. Each physical mechanism may limit the gasification rate within some range of pore size, particle size, gas temperature and gas pressure. The gasification rate per pore tree is integrated over a pore distribution function to determine the total gasification rate. In general, no single mechanism controls the entire gasification process. However, the known results of existing models are recovered in the extreme limits of kinetic and diffusion controlled gasification. (Author)

**A79-50914** Char gasification. II - Oxidation results. P F Lewis and G A Simons (Physical Sciences, Inc., Woburn, Mass.) *Combustion Science and Technology*, vol. 20, no 3-4, 1979, p 117-124. 23 refs. Contract No. E(04-3)-1254.

The basic heterogeneous reaction rates for the oxidation of porous carbon char have been inferred from existing laboratory data. These rates have been used to verify the basic transport model described in Part I (1979). Empirical verification has been obtained for temperatures between 630 and 2270 K, particle sizes between 4 and 89 microns in diameter and for chars from high, intermediate and low rank coals. The pressure dependence of the transport model has been verified only in the range of 0.1 to 0.2 atm of O<sub>2</sub>. Additional low pressure laboratory data are necessary in order to verify the basic model over a wider pressure range. (Author)

**A79-50932** A solid-state solar-powered heat transfer device. M. Belic (City College, New York, N.Y.) and J. I. Gersten (Jerusalem, Hebrew University, Jerusalem, Israel, City College, New York, N.Y.) *Journal of Applied Physics*, vol. 50, Sept. 1979, p 5682-5685.

A solar-powered solid-state heat transfer device capable of operating in either a refrigeration or a heat-pump mode is proposed. The device's operation is based on the combined utilization of the photovoltaic and Peltier effects. (Author)

**A79-50937** Gallium arsenide films and solar cells on graphite substrates. S S Chu, T L Chu, and M S Lan (Southern Methodist University, Dallas, Tex.) *Journal of Applied Physics*, vol. 50, Sept. 1979, p. 5805-5809. 8 refs. Contract No. EY-76-C-03-1284.

Gallium arsenide films have been deposited on graphite substrates by the reaction of gallium, hydrogen chloride, and arsine in a hydrogen flow. The structural and electrical properties of gallium arsenide films have been investigated. The interface between un-

doped gallium arsenide and graphite exhibits rectifying characteristics, however, a heavily doped interlayer reduces the interface resistance to a tolerable level. MOS-type solar cells prepared from n-GaAs/n(+)-GaAs/graphite structures have AM1 efficiencies of higher than 6% (Author)

**A79-50950** An anomalous photocurrent in SnO<sub>2</sub>-Si heterojunction solar cells. T Rodriguez, J S Maudes, and C Dehesa (Madrid, Universidad Politecnica, Madrid, Spain) *Journal of Applied Physics*, vol 50, Sept 1979, p 6011-6013

An anomalous photocurrent observed in reverse-biased SnO<sub>2</sub>-Si heterojunctions, obtained by spraying, is reported. This current becomes voltage independent above a certain reverse voltage value and is much larger than expected from the number of photopairs generated. The anomalous photocurrent occurs above a minimum voltage value and a minimum number of incident photons, these thresholds being constant for each cell. The anomalous photocurrent is generated under the SnO<sub>2</sub> window, its density being larger under the window edge region (Author)

**A79-50999 #** Supplementary RF plasma heating in tokamaks (Dodatečný vysokofrekvenční ohrev plazmatu v tokamacích). V Kopecký and J Musil (Československá Akademie Ved, Ústav Fyziky Plazmatu, Prague, Czechoslovakia) *Československý časopis pro fyziku, Sekce A*, vol 29, no 4, 1979, p 358-371 40 refs In Czech

Supplementary plasma heating up to temperatures necessary for controlled fusion is a very important physical and technological problem. This paper analyzes different methods of RF heating and possibility of their utilization for plasma heating in tokamak installations. A short survey of main parameters of operational tokamaks and those under construction is given as well. Czechoslovak activity in this field and the Czechoslovak tokamak Tm-1-MH is also described (Author)

**A79-51008 \*** Annealing kinetics of electron-irradiated GaAs heteroface solar cells in the range 175-200 C. G H Walker and E J Conway (NASA, Langley Research Center, Hampton, Va) *Applied Physics Letters*, vol 35, Sept. 15, 1979, p 459, 460 7 refs

Annealing of electron-irradiation damage in GaAs solar cells is important for space applications. This paper describes studies conducted to understand this annealing process. GaAs heteroface solar cells were irradiated with 10 to the 15th 1-MeV electrons/sq cm followed by thermal annealing. An activation energy for annealing of 1.25 + or - 0.14 eV and a frequency factor of (3.7 + or - 1.9) x 10 to the 9th per sec were determined. A small component of the irradiation damage which does not anneal measurably at 200 C was observed (Author)

**A79-51022** Statistical correlation between daily and monthly averages of solar-radiation data. B Bartoli, S Catalanotti, V Cuomo, M Grancesca, C Serio, V Silvestrini, and G Troise (Napoli, Università, Naples, Italy) *Nuovo Cimento C, Serie 1*, vol 2C, Mar-Apr 1979, p 222-234 11 refs. Research supported by the Consiglio Nazionale delle Ricerche

A correlation between the monthly average of the fraction of solar radiation reaching the earth and the statistical distribution of the days belonging to such a month as a function of the daily fraction of the daily fraction of solar radiation is analyzed. It is found that this correlation exists in Italy and that the distribution functions are independent of the location and of the period of the year (Author)

**A79-51024** Results of computer simulation of in situ oil shale retorting. R L Braun (California, University, Livermore, Calif) *In Situ*, vol 3, no 3, 1979, p 173-207 21 refs. Contract No W-74050-eng-48

A mathematical model has been developed for simulating the processes involved in the in situ retorting of rubblelized beds of oils shale. The model is a transient one-dimensional treatment of a packed-bed reactor and is based on the thermodynamics and kinetics of the numerous chemical reactions and physical processes that are most important for hot inert-gas retorting and for combustion retorting. The validity of the model is tested by comparison with experimental retort data. The predicted retorting results for conditions of interest to commercial, modified, in situ retorting are discussed in detail. The initial shale properties, such as grade, carbonate content, and bed porosity, are shown to have an important bearing on the maximum retort temperature, the rate of retorting, and the oil yield. The input-gas properties, such as composition, flow rate, and temperature, are likewise shown to influence strongly the retorting results (Author)

**A79-51025** Analysis of geological limitations to underground coal gasification. R F Strickland and J W Jennings (Texas A & M University, College Station, Tex) *In Situ*, vol 3, no 3, 1979, p 209-226 6 refs

Results of a field test of the underground gasification processes have shown that a high moisture content lignite can be easily ignited. Both the field test and a mathematical model study have shown that it may be difficult if not impossible to gasify lignite seams in close proximity to water sands (Author)

**A79-51100 \* #** Comparison of alternate fuels for aircraft. R D Witcofski (NASA, Langley Research Center, Hampton, Va) *Deutsche Gesellschaft für Luft- und Raumfahrt und Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, International Symposium on Hydrogen in Air Transportation, Stuttgart, West Germany, Sept 11-14, 1979, Paper 37* p 19 refs

A comparison of candidate alternate fuels for aircraft is presented. The fuels discussed include liquid hydrogen, liquid methane, and synthetic aviation kerosene. Each fuel is evaluated from the standpoint of production, transmission, airport storage and distribution facilities, and use in aircraft. Technology deficient areas for cryogenic fuels, which should be advanced prior to the introduction of the fuels into the aviation industry, are identified, as are the cost and energy penalties associated with not achieving those advances. Environmental emissions and safety aspects of fuel selection are discussed. A detailed description of the various fuel production and liquefaction processes and their efficiencies and economics is given. V T

**A79-51103 \* #** UV blocking filters for polymeric films. G J Rayl (General Electric Co, Space Div, Valley Forge, Pa) *American Vacuum Society, Meeting, Princeton, N.J., May 17, 1979, Paper 17* p 5 refs. Contract No NAS3-21264

The concept of incorporating UV screening agents in silicone resins as a means of protecting underlying solar cell covers and adhesives from UV degradation is presented. A silicone hard-coat resin incorporating a UV screening agent was selected as a suitable coating material for PFA Teflon solar cell covers. Consideration is given to fabrication procedures and techniques for introduction of the UV screening agents into silicone resins and application of these UV-inhibited coatings to the Teflons. Some preliminary environmental tests, such as thermal shock and temperature humidity, were conducted. V T

**A79-51177** Optical simulation for a fixed spherical solar collector. B Authier, L Hill, M Duban, P Trarieux, M Sarazin, and P Nadeau (CNRS, Laboratoire d'Astronomie Spatiale, Marseille, France) *Applied Optics*, vol 18, Sept 15, 1979, p 3081-3089 6 refs

To calculate the absorber dimensions for a fixed spherical solar collector, an optical simulation of the ray-tracing type is proposed. The physical quantities, which have an effect upon these dimensions, are described as well as the measurement methods. Once the

dimensions are determined, the incident flux on the absorber surface can be calculated by the same program in terms of different zenith distances. These calculations can be checked by comparing the calculated flux on the surface of the absorber with the measured flux at different points along the absorber aimed at the full moon instead of at the sun. Through the data obtained from the measurements, fluctuating points of high flux and permanent zones which receive double and triple reflection rays have been studied. (Author)

**A79-51178 Luminescent solar concentrators I - Theory of operation and techniques for performance evaluation** J S Batchelder (California Institute of Technology, Pasadena, Calif.), T Cole (Ford Motor Co., Dearborn, Mich.), and A H Zewail *Applied Optics*, vol 18, Sept 15, 1979, p 3090-3110 32 refs. Research supported by the U.S. Department of Energy and ARCO Solar, Inc.

Techniques and calculations are presented that give explicit expressions for the over-all performance of a luminescent solar concentrator (LSC) in terms of the intrinsic spectral response and quantum efficiency of its constituents. We examine the single dye (or inorganic ion) LSC with emphasis on the planar geometry. Preliminary data on the degradation of candidate LSC dyes under severe weathering conditions are also given. Armed with our experimental results and analysis of solar absorption, self-absorption, and solar cell efficiency, we present a new genre of solar concentrator with a theory of operation for the device. (Author)

**A79-51181 Optical properties of aggregated gold on aluminum** T Sato, K Y Szeto, and G D Scott (Toronto, University, Toronto, Canada) *Applied Optics*, vol 18, Sept 15, 1979, p 3119-3122 7 refs. Research supported by the Natural Science and Engineering Research Council of Canada.

The optical reflectances of evaporated deposits of gold on aluminum have been measured in the visible and IR regions. Aggregation of the gold and diffusion of the aluminum into the gold by heat treatment produces surfaces with high absorptance in the visible and high reflectance in the infrared, characteristics required of selective solar absorbers. The effects of prolonged heating at 350 C are shown to be slight. (Author)

**A79-51194 High-grade fuels from biomass farming - Potentials and constraints.** P B Weisz and J F Marshall (Mobil Research and Development Corp., Central Research Div., Princeton, N.J.) *Science*, vol 206, Oct 5, 1979, p 24-29 23 refs.

The use of biomass as a source of fuel is a topic of growing interest and debate. Here we present an analysis of the key technical and economic potentials and constraints of systems designed to use agricultural crops to displace nonrenewable hydrocarbon fuels, namely petroleum and natural gas. We first examine the controlling parameters and general behavior of such systems. We then examine the quantitative aspects of existing grain alcohol technology. This technology we use as a reference case for examining the potential for other biomass crops. It is our intent to provide a rigorous treatment and descriptive framework to aid in future research and development. (Author)

**A79-51196 Catalytic production of high-grade fuel /gasoline/ from biomass compounds by shape-selective catalysis.** P B Weisz, W O Haag, and P G Rodewald (Mobil Research and Development Corp., Central Research Div., Princeton, N.J.) *Science*, vol 206, Oct 5, 1979, p 57, 58 19 refs.

Shape-selective hydrocarbon catalysis, such as the conversion capability of zeolite catalysis of the ZSM-5 type to produce high-grade gasoline from methanol, can be extended to produce a similar gasoline or aromatics from plant extracts. Examples are rubber latex, corn oil, and peanut oil. Novel mechanisms for shape-selective reaction sequences are demonstrated. (Author)

**A79-51250 # The design impact of power-augmented ram technology on large energy efficient aircraft.** C J Martin and F H. Krause (U.S. Naval Material Command, David W. Taylor Naval Ship

Research and Development Center, Bethesda, Md.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, New York, N.Y., Aug 20-22, 1979, Paper 79-1864* 11 p 17 refs.

The purpose of this paper is to present the energy saving advantages of power-augmented-ram (PAR) technology as applied to large aircraft. The increased efficiency in the areas of aerodynamic structures and propulsion are quantified. The requirements for the application of PAR to energy conservative aircraft flying in ground effect (WIG) or out of ground effect are presented. The design limitations and performance gains associated with PAR are identified. The PAR provides a substantial system performance improvement to aircraft designs flying either in or out of ground effect. Fuel efficient PAR-WIG vehicles, compared to conventional land based aircraft, are capable of three times the payload delivered for a pound of fuel used. (Author)

**A79-51274 # Application of automatic control methods to the inspection of the state and the testing of the power-generating systems of hydroelectric power plants (Ispol'zovanie sredstv avtomatizirovannogo upravleniya dlia kontrolya sostoiانيا i ispytaniu gidrosilovogo oborudovaniia GES)** V I Obrezkov, N K Malinin, M G Tiagunov, N I Matvienko, and V D Lebedeva (Moskovskii Energeticheskii Institut, Moscow, USSR) *Energetika*, vol 22, June 1979, p 78-82. In Russian.

**A79-51405 Advanced lasers for fusion applications** W F Krupke (California, University, Livermore, Calif.) In *International Conference on Lasers, Orlando, Fla., December 11-15, 1978, Proceedings* McLean, Va., STS Press, 1979, p 24-30 36 refs. Contract No. W-7405-eng-48.

The technological scalability and efficiency of short-wavelength laser systems based on atomic selenium, terbium molecular vapors, thulium-doped dielectric solids and pulse compressions of KrF excimer laser radiation for laser fusion applications are examined. Preliminary device and system models for each of the laser systems considered were applied to the design of a nominal kilojoule/terawatt laser system, and technological and physical problems in the scaling of the systems to the energy of 100 kJ/beamline were assessed. It is found that all of the laser concepts examined (laser-pumped, and window and windowless fluorescence pumped OCSe systems, a XeF excimer-laser pumped Tm(3+) glass laser, KrF-pumped Tb thd3 and Tb-Al-Cl systems and a KrF-pumped backward-wave pulsed Raman stacker-compressor laser using methane as the Raman medium) are capable of meeting the minimum energy efficiency requirements of 1% and are potentially scalable to the required levels, with the KrF-pumped CH4 Raman stacker/compressor system offering the highest efficiency (4 to 6%) at the shortest wavelength (0.27 microns) and the widest range of system design options. A L IV

**A79-51570 Study of driven lower-hybrid waves in the Alcator tokamak using CO2-laser scattering.** C M Surko, J J Schuss, R R Parker, I H Hutchinson, D Overskei, and L S Scaturro (MIT, Cambridge, Mass.) *Physical Review Letters*, vol 43, Oct 1, 1979, p 1016-1019 8 refs. Contract No. EG 78 C 3109.

The wavelengths, amplitudes, frequencies, and spatial distributions of driven lower-hybrid wave fluctuations are studied in the Alcator tokamak with use of CO2 laser scattering. It is found that for incident microwave power densities from 0.4 to 4.5 kW/sq cm the wave amplitudes are nearly independent of the relative phase of the electric fields at the exciting waveguides. The waves are not localized in resonant cones and they have frequency widths of from 0.5 to 6 MHz. (Author)

**A79-51705 # An advanced technology engine family for general aviation** J L Nye (General Electric Co., West Lynn, Mass.) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1161* 6 p.

The design features of the GE advanced technology CT7 turboshaft engine, a civilian derivative of the U.S. Army T700, are surveyed. The engine is the result of a development program which included studies of various configuration alternatives early in the design cycle. It is shown how the engine's features reduce operating costs. These include reduced specific fuel consumption and weight, high reliability, simplified maintenance and improved cost/benefit ratio. The engine features 97% commonality with the T700 and is made up of four major components, an accessory module, a cold-section/compressor module, a hot-section/turbine module, and a power turbine module. Performance improvements are covered and derivatives such as a turboprop and a turbofan are noted. M E P.

**A79-51712** **Urania-yttria solid solution electrodes for high-temperature electrochemical applications.** S P S Badwal and D J M Bevan (South Australia, Flinders University, Adelaide, Australia). *Journal of Materials Science*, vol 14, Oct 1979, p 2353-2365. 64 refs

Measurements of total electrical conductivity of fluorite-type U3O8-Y2O3 (Sc2O3) solid solutions are studied as a function of temperature and U/Y (Sc) ratio. The study includes experimental data on total conductivity, transport numbers, and interdiffusion of electrode and electrolyte cations. It is found that the conductivity of these fluorite-type solid solutions is mainly electronic and the conduction mechanism being of the hopping-type. The diffusion of cations of U3O8-Y2O3 into ZrO2-Y2O3 is evaluated. Attempts were made to determine the anionic contribution to the total conductivity in U3O8-Y2O3 solid solutions, using the blocking electrode technique. The diffusion coefficients calculated from the conductivity data using the Nernst-Einstein relation are two orders of magnitude higher than those obtained by a direct method. V T

**A79-51726** **Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volumes 1 & 2.** Conference sponsored by ACS, AIChE, AIAA, ANS, ASME, IEEE, and SAE. Washington, D.C., American Chemical Society, 1979. Vol 1, 1219 p., vol 2, 1179 p. Price of two volumes, \$52.50

Consideration is given to such topics as solar collectors, solar ponds, solar thermal systems, solar thermal components, OTEC systems, photovoltaic systems, wind power, desiccant cooling, biomass conversion, flywheel energy storage, compressed air energy storage technology, and thermal and magnetic energy storage. Papers are also presented on thermal energy storage for building space conditioning, fuel cells, electric vehicle systems, batteries for electric vehicles, hydrogen energy, coal liquefaction and gasification, fluidized bed processing for energy conversion systems, in situ oil shale and gas technology, geothermal energy, heat engines, and Stirling engine analysis. Finally, attention is also given to space power system requirements, satellite solar arrays, aircraft power systems, space nuclear reactor/isotope power systems, controlled fusion, thermoelectrics, thermionics, and magnetohydrodynamics. B J

**A79-51727** **Weight minimization of sandwich type solar collector panels.** R C Reuter, Jr (Sandia Laboratories, Albuquerque, N. Mex.). In *Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 1*. Washington, D.C., American Chemical Society, 1979, p 1-6. 5 refs. Contract No. AT(29-1)-789.

Solar collector modules of various types (e.g., line focusing, heliostats) require stiff, lightweight structural panels to support and protect their reflective surfaces. Symmetric, sandwich type panel construction fulfills these requirements. Analytical methods are utilized in the present work to study the existence, utilization and practicality of a minimum weight, adequately stiff design for sandwich panel construction in the solar collector application.

(Author)

**A79-51728** **Elastically deformed, linear focusing solar reflector.** R A Powell (HRP, Inc., Norristown, Pa.). In *Intersociety*

*Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 1*

Washington, D.C., American Chemical Society, 1979, p 7-10

A low-cost, high-quality, linear-focusing reflector can be produced by applying twisting moment loads to the longitudinal edges of an initially flat sheet of reflector material. This causes it to elastically deflect to a cylindrical cross-section. Additional loads force the cross-section shape into that of a parabola. Experiments using a test bed that simulates a two foot (0.61 m) long section of a six-foot (1.83 m) wide reflector made by this method support the theory. A stable, and structurally stiff reflector is produced, having a geometric concentration ratio of 21 in the cylindrical configuration and 88 in the parabolic configuration. A production design that is simple, does not require large capital outlays, and has material costs in the range of \$75/sq m is discussed. (Author)

**A79-51729** **Optical-thermal performance analysis for a fixed mirror-distributed focus solar-thermal-electric power system.** L D. Clements and J. D. Reichert (Texas Tech University, Lubbock, Tex.). In: *Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 1*. Washington, D.C., American Chemical Society, 1979, p 11-14. 9 refs

This paper is concerned with both optical and thermal analyses for a fixed mirror-distributed focus (FMDF) system. This work has arisen as a part of the Crosbyton Solar Power Project at Texas Tech University. The paper addresses both detailed and approximation modeling of the optical concentration profiles and modeling of receiver performance for a once-through steam boiler receiver for the FMDF concept. The final performance results are given in terms of enthalpic power absorbed as a function of solar inclination angle, fluid inlet conditions, and windspeed. (Author)

**A79-51730 \*** **A simulation exercise of a cavity-type solar receiver using the HEAP program.** F L Lansing (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In *Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 1*. Washington, D.C., American Chemical Society, 1979, p 20-25. Contract No. EX-76-A-29-1060

A computer program has been developed at JPL to support the advanced studies of solar receivers in high concentration solar-thermal-electric power plants. This work presents briefly the program methodology, input data required, expected output results, capabilities and limitations. The program was used to simulate an existing 5 kw experimental receiver of a cavity type. The receiver is located at the focus of a paraboloid dish and is connected to a Stirling engine. Both steady state and transient performance simulation were given. Details about the receiver modeling were also presented to illustrate the procedure followed. Simulated temperature patterns were found in good agreement with test data obtained by high temperature thermocouples. The simulated receiver performance was extrapolated to various operating conditions not attained experimentally. The results of the parameterization study were fitted to a general performance expression to determine the receiver characteristic constraints. The latter were used to optimize the receiver operating conditions to obtain the highest overall conversion efficiency. (Author)

**A79-51731** **Ceramic solar receivers.** P O Jarvinen (MIT, Lexington, Mass.). In *Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 1*. Washington, D.C., American Chemical Society, 1979, p 26-31. Research sponsored by the U.S. Department of Energy

The application of ceramic materials to high temperature solar receivers for advanced Brayton and advanced Stirling thermal electric systems is discussed. Conceptual designs for ceramic cavity receivers employing impingement jet-cooled, dome-shaped silicon carbide heat exchanger modules are offered. Optical, mechanical, heat transfer and structural analyses of this novel receiver approach are presented. (Author)

**A79-51732** Predicting solar energy fluxes in polluted urban areas. T R Galloway (California, University, Livermore, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 32-38 9 refs Contract No W-7405-eng-48

The paper presents a method which employs known molecular absorption coefficients for gaseous air pollutants and various manmade and natural aerosols in an urban atmosphere model to predict the atmospheric optical thickness and thus the ratio of ground level direct incident flux to insolation flux above the atmosphere. In addition, a prediction method is developed for representative values of the 'unpolluted air' background, making it possible to derive an urban solar energy correction factor. Detailed daily local measurements have been made over a two year period in the San Francisco Bay Area in order to verify the overall accuracy and sensitivity of the method to various air pollutant input parameters. The method reduces the incident solar flux design error from the typical 30% to less than 5% for urban areas. B J

**A79-51733 \*** Projected techno-economic improvements for advanced solar thermal power plants. T Fujita, R Manvi, and E J Roschke (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 39-44 25 refs Research sponsored by the U.S. Department of Energy

The projected characteristics of solar thermal power plants (with outputs up to 10 MWe) employing promising advanced technology subsystems/components are compared to current (or pre-1985) steam-Rankine systems. Improvements accruing to advanced technology development options are delineated. The improvements derived from advanced systems result primarily from achieving high efficiencies via solar collector systems which (1) capture a large portion of the available insolation and (2) concentrate this captured solar flux to attain high temperatures required for high heat engine/energy conversion performance. The most efficient solar collector systems employ two axis tracking. Attractive systems include the central receiver/heliostat and the parabolic dish. (Author)

**A79-51734** Solar pond concepts - Old and new. T S Jayadev, M Edesess, and J Henderson (Solar Energy Research Institute, Golden, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 45-48 16 refs

It is shown that the salty nonconvecting pond is a viable and economical way of collecting and storing large quantities of solar energy, especially where salt is free or inexpensive. Other techniques may be more desirable where salt is not so readily available. Combinations of collectors with pond storage are appropriate for some applications and can provide water of higher temperature, but they enter the realm of higher and more expensive technology. Where salt is not free or not inexpensive the deep convecting pond may be an economically viable and environmentally acceptable alternative and deserves further investigation. B J

**A79-51735** Performance of a large, salt-gradient solar pond. L J Wittenberg and M J Harris (Monsanto Research Corp., Miamisburg, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 49-52 11 refs Contract No DE-AC04-76DP0053

Initial performance data collected from the largest, salt-gradient solar pond in the U.S. indicate that it has the potential to be a very low-cost solar-heating system. The solar pond at Miamisburg, Ohio, occupies an area of 2000 sq m and was installed for only \$35/sq m. The pond is predicted to deliver 281,000 kW hr/yr to be used principally for heating an outdoor swimming pool in the summer and a recreation building during October-December. Based upon straight

amortization of 10%/yr, this heat is predicted to cost 2.5 cents/kW hr (Author)

**A79-51736** Stability criteria for saturated solar ponds. T L Ochs and J O Bradley (Nevada, University, Boulder City, Nev.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 53-55 8 refs

Saturated solar ponds are nonconvecting bodies of water, relying upon a density gradient brought about by differential solubility of salt with temperature. A saturated solar pond differs from a typical saline pond in that the naturally-developed temperature gradient between top and bottom develops and maintains a density gradient by ion migration. Not all salts are suitable for use in a saturated solar pond and the paper describes criteria for their choice and an example of analysis of four candidate salts. (Author)

**A79-51737** Economic and performance comparisons of salty and saltless solar ponds. M Edesess, D Benson, J Henderson, and T S Jayadev (Solar Energy Research Institute, Golden, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 56-61 16 refs

The optimum solar pond design is site-dependent and application dependent. Foremost of the design decisions is the choice of a salty (nonconvecting) pond or a saltless (convecting) pond. The decision variables are local availability and cost of salt, type of salt available and its properties, and possible environmental factors such as the effects of salt runoff and the existence of ground water. The availability of salt is an important factor in determining the economics of salty ponds. For example, sodium sulfate is a potentially low-cost substitute for sodium chloride, and is expected to be in plentiful and widely distributed supply in the near future as a waste product of flue gas desulfurization at coal-fired utility plants. This paper discusses the potential supply of such salts and estimates the break-point in net cost of salt at which a convecting pond becomes economically competitive with the salty pond. (Author)

**A79-51738** Sede Boquer - Shallow solar ponds project. A I Kudish and A Roy (Negev, University, Beersheba, Israel) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 62-65 5 refs

The results obtained at the Sede Boquer shallow solar ponds project are presented. The project consists of three small module shallow solar ponds, 2 x 1.3 m in size. All have the same lower black PVC lower film but differ either in the type of upper transparent film, glazing material or glazing angle. Performance data are presented for three criteria: (1) maximum daily water temperature achieved, (2) total daily thermal energy collected and the daily efficiency. Finally, the data are analyzed through application of the Hottel, Whillier and Bliss model and following the approach developed by Hewett (1977). M E P

**A79-51739 \*** Advanced solar thermal technology - Potential and progress. L Leibowitz and E Hanseth (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 66-71 6 refs Research sponsored by the U.S. Department of Energy

The advanced thermal power technology program which develops and applies advanced technology for improved solar thermal energy subsystems and components. It is shown that the effort is aimed at systems which can achieve significant energy cost reductions. The paper describes the potential for advanced technology to

achieve commercially attractive solar thermal systems and describes some recent developments in advanced heat engines, high temperature receivers, chemical transport, and storage  
M E P

**A79-51740** **Solar thermal systems long-term performance predictions using closed-form solutions** D K Anand, R B Abarcas, and S R Venkateswaran (Maryland, University, College Park, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 72-76 6 refs Contract No. EY-76 S-05-4976

In this paper, a closed loop feedback control system representation of solar thermal system is derived for each of the various modes of operation. Analysis of the transfer functions resulted in identifying the various system parameters which must be optimized in order to obtain the maximum system response to a continuous input weather function. Using a stochastic weather model, which has been validated through the detailed simulation program SHASP, as input, the thermal response of the system is obtained in a closed form. A methodology for using the closed-form solution to represent the response, and the joint probability density matrix to represent the probabilistic nature of the weather to obtain the long term system performance is presented. The results are compared to the predictions of both the detailed simulation and the simplified design method  
(Author)

**A79-51741** **A distributed microcomputer-based control system for a large scale solar total energy system** J O Farrell and R S Reska (General Electric Co., Daytona Beach, Fla.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 77-81 Contract No. DE-AC04 77ET20260

A unique computer based digital control system is being designed by General Electric to control, monitor, and acquire data from the world's largest industrial solar thermal energy system, the U.S. Department of Energy's Solar Total Energy - Large Scale Experiment at Shenandoah, Georgia. The control system employs distributed microcomputer architecture, a human factors engineered control console, and Large Scale Integrated (LSI) electronics hybrid signal conditioning to control solar energy collection, storage, conversion, and utilization. The total energy system can thus operate under either automatic or manual control to produce electricity, process steam, and provide space heating and cooling for a large knitwear manufacturing plant  
(Author)

**A79-51742** **The control system for Fort Hood Solar Total Energy System** F C Luffey and D L Black (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 82-85

The Fort Hood Solar Total Energy System Large Scale Experiment (STES LSE) was designed to supply 70 million Btu/day to the 87 thousand barracks complex at Fort Hood, Texas. Solar energy is collected via a mirrored parabolic trough and delivered to thermal storage tanks from which the balance of the plant operates up to 24 hours per day. Thermal energy is then converted to electrical power, domestic hot water, space heating in winter and air conditioning in summer. The control of the components of the STES-LSE is via a 'software driven' digital computer based control system interfaced with analog control elements. A master computer located in the central control room communicates asynchronously to field distributed process units (DPU) via parallel linked transmission lines. These DPU's contain control algorithms, control commands, and setpoints which are relayed to either conventional analog controllers or analog actuators via signal conditioned I/O terminal boards located in the DPU  
(Author)

**A79-51743** **Perspectives on developing country solar energy applications** R Ramakumar (Oklahoma State University, Stillwater, Okla.) and J C Beavers. In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 93-98 32 refs. Research supported by the Oklahoma State University, Contract No. EV-78-S-05-6004

This paper discusses some of the fundamental issues involved in the harnessing of renewable energy resources for rural development in developing countries. Utilization of several manifestations of solar energy in tandem, with the integration of benefits occurring at the user's end, appears to be attractive both from the application and the economic points of view. This can be achieved by the establishment of a rural energy center for each remote village or for a small cluster of three or four villages. It is shown that, in resource-poor population rich countries which have to import fossil fuels at the expense of their meager foreign exchange reserves, capital costs as high as US \$6000 per continuous kilowatt or even higher are permissible, and sometimes even competitive, at present for renewable energy systems. A selected chronological bibliography is compiled for the benefit of readers interested in additional information on this subject of global importance  
(Author)

**A79-51744** **Solar collector as heat pump evaporator** S Chaturvedi, A S Roberts, Jr (Old Dominion University, Norfolk, Va.), and V Mei (Illinois Institute of Technology, Chicago, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 99-104

Thermal performance of a solar assisted heat pump is analyzed for various ambient conditions. In the proposed concept, bare collector also acts as evaporator for the heat pump. Results indicate that evaporator temperature 0 to 15C above ambient temperature can be maintained for wide ranging ambient conditions. Long term system performance of the system for Norfolk, Virginia indicates that payback period of 12 years is possible for a base electricity rate of \$0.06/kwhr, 10% fuel escalation rate and 8% interest rate. Payback period can be significantly reduced if the system is optimized and if the heat pump is also used for domestic water heating  
(Author)

**A79-51745** **Design study and cost-effectiveness of the metal hydride solar heat pump and power system /HYCSOS/** R Gorman and P S Moritz (TRW Energy Systems Group, McLean, Va.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 109-113 5 refs

This report presents the design, performance and cost-effectiveness of a solar-powered metal hydride heat pump and power system for use on a residence. The system design, which is limited by heat transfer, was optimized via an interactive computer program. The results indicate that in Boston, the HYCSOS with electric back-up uses less than one third the electricity annually and costs 23 percent less than direct solar heating with absorption air conditioning and electric back-up. In comparison, the HYCSOS with gas back-up uses 89 percent less gas and 50 percent less electricity than gas heating and gas air conditioning. However, it costs 17 percent more per year to own and operate because of the high capital costs of HYCSOS. For Albuquerque the HYCSOS with electric back-up costs 27 percent less per year than direct solar heating with electric back-up, HYCSOS with gas back-up costs only 3 percent less per year  
(Author)

**A79-51746** **Conversion of solar energy to chemical energy using ammonia dissociation** T G Lenz and J H Wright (Colorado State University, Fort Collins, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1  
Washington, D C., American Chemical Society, 1979, p 114-117

This paper deals with design of an experimental solar absorber-ammonia dissociation reactor-heat exchanger. Such a composite absorber-reactor heat exchanger would be at the endothermic end of a closed cycle process for conversion of solar energy to high-quality process heat or electric power. The preferred design is for a 10 kWth unit of cylindrical-cavity geometry, about one foot in diameter by one foot long, and containing 43, 0.375 in OD, 0.245 in ID catalyst-filled Inconel 617 tubes running axially between two ring headers. Typical catalysts would be nickel or ruthenium on Al<sub>2</sub>O<sub>3</sub>. Total pressure drop (reactor plus heat exchanger) of 4.6 psi is predicted for a 4000 cu cm/min average volumetric flow (at 650 C, 300 bars), with 87 mole% of the NH<sub>3</sub> fed being converted to N<sub>2</sub> and H<sub>2</sub>. The dissociated gas temperature exiting the heat exchanger would be within 10 C of the inlet NH<sub>3</sub> temperature. (Author)

**A79-51747** **Dynamic simulation of a sodium-cooled, advanced central receiver solar-electric power plant** W Willcox (Rockwell International Corp., Energy Systems Group, Canoga Park, Calif.) and J Beckman (California State University, Northridge, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 118-123 11 refs

A numerical dynamic simulation model of the thermal hydraulic characteristics of a sodium-cooled advanced central receiver solar electric power plant has been developed. The model was used to determine the optimum receiver temperature control system configuration. Independent feedback control of each of the 24 receiver panels was found to be an adequate method of receiver outlet coolant temperature control. However, integral and derivative control modes, as well as proportional, are required for satisfactory response speed and acceptable temperature offset. The use of simple independent feedback loops for control does not cause any unusual problems even though the panels are hydraulically coupled by common feed and return lines. The degree of coupling was found to be small. Arbitrarily inducing instability in one panel does not affect the operation or control of the other panels. The limits of controller stability were explored by parametrically varying controller proportional gain. It was found that the receiver panels with the highest heat flux and coolant flow were the most sensitive to gain variation as a result of their relatively high ratio of dead time to process time constants. (Author)

**A79-51748** **Solar production of industrial process steam.** J Cherne, G Gelb, and D Pinkerton (TRW Energy Systems Group, Redondo Beach, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 124-128. Research sponsored by the U.S. Department of Energy.

TRW is developing the application of solar technology to food processing at the Ore-Ida Foods plant in Ontario, Oregon, under the auspices of the Department of Energy. Steam, generated at 417 F, is used for frying, then cascaded to lower temperatures for other processes in the plant. This plant consumes all of the solar-produced steam without the need for costly storage. The system selected consists of high efficiency, parabolic trough, concentrating collectors and a pressurized water heat transfer loop which generates steam in a flash tank. This system is applicable to many industries. The system interfaces with the industrial process by simply teeing into the existing process steam lines. This paper treats the trade-offs performed to select the system configuration. (Author)

**A79-51749** **The solar total energy system evaluation program /STESEP/** B L McFarland (Rockwell International Corp., Energy Systems Group, Canoga Park, Calif.), S J Nalbandian, and E P French (Rockwell International Corp., Space Systems Group, Downey, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 129-132 11 refs

A solar total energy system (STES) uses solar energy as the primary source to provide a combination of electrical and thermal power to the user to supplement or replace conventional energy sources. Either photovoltaic or solar thermal collectors can be used. Both can be evaluated by the solar total energy system evaluation program (STESEP) Computer Program to determine the equipment sizes and control methodology best suited to building applications in the commercial sector. This paper describes and discusses application of the STESEP Code which can be extended to evaluation of STES in general. (Author)

**A79-51750 \*** **Dynamics and control of Stirling engines in a 15 kW solar electric generation concept** R L Das and K A Bahrami (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 133-138 6 refs. Contract No. NAS7-100

This paper discusses the application of kinematic and free piston Stirling engines in a 15 kW dish-electric approach for solar thermal electric generation. Initially, the principle of operation of Stirling engines in solar thermal electric generation is discussed. Then, under certain simplifying assumptions, mathematical models describing the dynamic operation of the kinematic and free piston Stirling engines are developed. It is found that the engine dynamics may be approximated by second order models. Control mechanisms for both types of Stirling engines are discussed. An approach based on the modulation of the working fluid mean pressure is presented. It is concluded that this approach offers a fast and effective means of control. The free piston Stirling engine, being a thermally driven mechanical oscillator, presents unique control requirements. These are discussed in this paper. (Author)

**A79-51751 \*** **Turbine sizing of a solar thermal power plant** R Manvi and T Fujita (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 139-142. Contract No. EX-76-A-29-1060

Since the insolation is intermittent, thermal energy storage is necessary to extend the time of power generation with solar heat past sunset. There are two approaches to specifying the size of turbine-generator units depending on the system operation. In the first approach, the turbine operates at its full capacity when operating on direct solar heat, and at reduced capacity when operating on collected heat out of energy storage. In the second approach, the turbine will always operate at a uniform level either on derated energy from the receiver or from energy storage. Both of these approaches have certain advantages and disadvantages. In this paper, a simple analysis is outlined and exercised to compare the performance and economics of these two approaches. (Author)

**A79-51752** **Sandia Laboratories operational experience with small heat engines in solar thermal power systems** J P Abbin, Jr (Sandia Laboratories, Albuquerque, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 143-147. Contract No. DE-AC04 76DP00789

During the time that Sandia Laboratories has been engaged in solar energy research and development, a significant amount of hardware and operating experience has been obtained from the construction and testing of two small Rankine-cycle solar thermal power plants. The first plant is part of a prototype solar total energy system with an electrical generating capacity of 32 kW, and the second plant is part of a prototype solar irrigation unit with a shaft power output of 19 kW or an electrical output of 15 kW. This paper describes the energy-conversion hardware and summarizes the performance and operating experience with the units. (Author)



**A79-51754** **A new solar thermal receiver utilizing a small particle heat exchanger** A J Hunt (California, University, Berkeley, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 159-163 10 refs Contract No W-7405-eng-48

A dispersion of small absorbing particles forms an ideal system to collect radiant energy from concentrated sunlight to heat a pressurized gas that when expanded through a turbine will produce useful mechanical energy. A new type of solar thermal receiver based on this concept is being developed at LBL that is to be placed at the focus of a central tower or a parabolic dish concentrator system. An open cycle Brayton heat engine utilizing a Small Particle Heat Exchange Receiver (SPHER) operates by compressing ambient air and injecting a very small mass of fine particles into the gas stream. The air particle mixture enters a transparent heating chamber where the solar flux is concentrated. The particles absorb the radiation and because of their very large surface area, quickly release the heat to the surrounding gas. The air-particle mixture continues to heat until the particles vaporize. The optical efficiency of the receiver is 85-90% without a cavity and the thermodynamic efficiency of the Brayton cycle is greater than 40%. Calculations of the optical, thermal, and physical processes have been performed, candidate receiver designs and window materials have been determined, and the feasibility demonstrated in the laboratory (Author)

**A79-51755 \*** **Solar parabolic dish thermal power systems - Technology and applications.** J W Lucas and A T. Marriott (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 166-175 19 refs Research sponsored by the U S Department of Energy.

Activities of two projects at JPL in support of DOE's Small Power Systems Program are reported. These two projects are the Point-Focusing Distributed Receiver (PFDR) Technology Project and the Point-Focusing Thermal and Electric Applications (PFTEA) Project. The PFDR Technology Project's major activity is developing the technology of solar concentrators, receivers and power conversion subsystems suitable for parabolic dish or point-focusing distributed receiver power systems. Other PFDR activities include system integration and cost estimation under mass production, as well as the testing of the hardware. The PFTEA Project's first major activity is applications analysis, that is seeking ways to introduce PFDR systems into appropriate user sectors. The second activity is systems engineering and development wherein power plant systems are analyzed for specific applications. The third activity is the installation of a series of engineering experiments in various user environments to obtain actual operating experience (Author)

**A79-51756** **Solar central receiver program.** L. N. Tallerico and A. C. Skinrood (Sandia Laboratories, Livermore, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D C., American Chemical Society, 1979, p. 176-180

A number of solar central receiver programs are being conducted with the goal of developing a system capable of producing low cost electricity. The programs are concentrating on the heliostat, receiver and storage subsystems. The emphasis in the heliostat program is to develop designs which are amenable to mass production and minimum maintenance. Both glass and plastic designs are being evaluated. The receiver studies have addressed the use of water/steam, salt, sodium, air and helium as the heat transport fluid in the receiver. Air, rock, salt, and sodium storage subsystems are being investigated. The water/steam, sodium and salt receivers are coupled to a Rankine cycle turbine and the air and helium receivers to a Brayton cycle turbine. Extensive parametric studies were conducted to obtain the information required to evaluate the systems. An overview of these systems, the scope of the parametric studies, the

preliminary conclusions, and the future direction of the program are presented (Author)

**A79-51757** **Solar One Project - A 10-megawatt solar thermal central receiver pilot plant** R N Schweinberg (U S Department of Energy, Solar Ten Megawatt Projects Office, El Monte, Calif.) and J N Reeves (Southern California Edison Co., Rosemead, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 181, 182

Through a cooperative effort of government and private industry, a 10-megawatt solar thermal pilot plant is to be constructed in the 1980-81 timeframe using central receiver technology. The pilot plant will be tested for five years and information derived will be used for future commercial solar generating stations (Author)

**A79-51758** **Preliminary design of a cruising OTEC modular experiment** J F George and D Richards (Johns Hopkins University, Laurel, Md.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 183-189 9 refs

Ocean Thermal Energy Conversion (OTEC) uses the temperature difference between warm surface water and cold deep water in a thermodynamic cycle with ammonia as the working fluid to drive a turbogenerator. This power source is available over vast areas of tropical and subtropical oceans. The Department of Energy development plan for OTEC calls for the acquisition of a modular experiment platform that can produce from 10 to 40 MW electric (net) power, using near full-scale power module components. A preliminary design of this platform has been completed and is available for use by government and industry. The paper describes the systems design of the OTEC platform, which integrates all of the requirements of sea water delivery, heat exchangers, power system components, and shipboard outfitting and furnishing. The cold water pipe is the most difficult technical problem to be solved, and analysis, design and deployment studies are discussed (Author)

**A79-51759** **An open cycle approach to ocean thermal energy conversion** P D Ritland and B Coffay (Westinghouse Electric Corp., Steam Turbine-Generator Technical Operations Div., Lester, Pa.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 195-202 7 refs Contract No EG-77-C-05-1473

A design for an open cycle 100 MW electric net ocean thermal energy conversion plant is described. In this system flashed seawater is used as the working fluid without resorting to an intermediate working fluid as is used in the closed cycle power system options. The design makes use of an ocean platform as integral part of the power system. A large diameter, low speed turbine with lightweight blades is used. The large quantities of noncondensibles require a special approach to the design of condenser and venting systems. The use of either direct contact or surface condensers is possible with a potential of fresh water production with the use of surface condensers. Attention is paid to hull stability to allow the use of barometric principles for fluid handling. The design, economic, and institutional issues relevant to commercialization are also discussed (Author)

**A79-51760** **A combined cycle for solar-fossil hybrid power generation** E. Y. Lam and J. H. Westsik (Bechtel National, Inc., San Francisco, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 203-206 Contract No DE AC03-78ET21050

A study of the combined cycle solar hybrid system concepts was initiated in October, 1978 at Bechtel as part of the Department of Energy's solar power development program. Parametric studies were conducted on a near term and an advanced version of a nominal 100

MWe commercial power system. These studies, combined with analyses of market potential in the 1985-1990 time frame, will serve as bases for selecting one of these two concept versions for conceptual design during the second half of this 12 month study. A technical and economic assessment of the concept and the preparation of a development plan and proposal will complete the study project. The combined cycle hybrid system selected by the Bechtel team for the study consists of an air operated open Brayton cycle with a steam Rankine bottoming cycle utilizing the gas turbine waste heat. Solar energy is used to preheat the air in the gas turbine cycle, with the air cooled receiver, located upstream from the combustor in a series arrangement. Cycle efficiencies of 43.5 and 47.7 percent and average annual solar fractions of .312 and .408 were predicted for the near term and advanced versions respectively. (Author)

**A79-51761 \*** **Solar thermal power plants in small utilities - An economic impact analysis.** S. A. Bluhm, R. R. Ferber (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and L. G. Mayo (Burns and McDonnell Engineering Co., Kansas City, Mo.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 207-211. Research sponsored by the U.S. Department of Energy.

A study was performed to assess the potential economic impact of small solar thermal electric power systems in statistically representative synthetic small utilities of the Southwestern United States. Power supply expansion plans were compared on the basis of present worth of future revenue requirements for 1980-2000 with and without solar thermal plants. Coal-fired and oil-fired municipal utility expansion plans with 5 percent solar penetration were 0.5 percent and 2.25 percent less expensive, respectively, than the corresponding conventional plan. At \$969/kWe, which assumes the same low cost solar equipment but no improvement in site development costs, solar penetration of 5 percent in the oil-fired municipal reduced revenue requirements 0.88 percent. The paper concludes that some solar thermal plants are potentially economic in small community utilities of the Southwest. (Author)

**A79-51762** **The design of photovoltaic systems for intermediate-sized applications.** E. L. Burgess and G. J. Jones (Sandia Laboratories, Albuquerque, N. Mex.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 212-218. 12 refs. Research supported by the U.S. Department of Energy.

The design techniques and resulting subsystem requirements for photovoltaic (PV) systems for intermediate load center applications are reviewed. The designs included total-energy systems, ac and dc loads, energy storage, utility feedback, and stand alone configurations. The National Photovoltaic Program for the development of low-cost flat-panel and concentrator PV arrays, and PV system design, including PV array types and sizes, power-conditioning unit, utility interface, electrical storage, system control, and thermal components are discussed. Three designs representative of commercial and industrial systems, utility feedback and system sizing, a total energy system, and a stand alone, dc load, energy storage system are described. Finally, economics of PV systems are analyzed, and it is concluded that their current costs are too high, but cost reduction areas are identified and programs established to reduce costs. A. T.

**A79-51763** **Performance of the Mead, Nebraska, 25 kWp photovoltaic solar energy system and comparison with simulation.** L. L. Bucciarelli and R. F. Hopkinson (MIT, Lexington, Mass.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 219-224. Research sponsored by the U.S. Department of Energy.

A photovoltaic solar energy system has been providing power for irrigation and crop drying at an agricultural field station of the University of Nebraska. The system, developed and maintained

jointly by MIT/Lincoln Laboratory and the University and under contract to the U.S. Department of Energy, consists of a 25 kWp PV array, a battery subsystem, an inverter, a controller, and a data collection and management system. Field data indicate that the PV array performs up to expectations if allowance is made for degradation. The array operates at an efficiency (based on cell area) of between 7 and 8%, the battery subsystem at an 'in-out' efficiency of 83%, and the inverter at 87%. During the irrigation season the system delivers 70% of the energy provided by the PV array to the pump motor. Approximately 10% of the array energy is wasted when the battery is in a fully charged state and the array power exceeds the load. Performance of the system was compared with the results of a computer simulation. This comparison showed agreement to within plus or minus 5% on daily energy totals for array output, inverter input, battery input and output. (Author)

**A79-51767** **Photovoltaic concentrator system for Roxborough Park.** R. L. Donovan, W. D. Miller (Martin Marietta Aerospace, Denver, Colo.), and J. Burleson (Childress-Livaudais Architects, Denver, Colo.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 245-250. Contract No. DE-AC04-78CS05312.

The Roxborough State Park Visitor's Center, located 25 miles southwest of Denver, Colorado is the planned site of a photovoltaic concentrator application experiment. The intent of the experiment is to demonstrate an energy independent application by combining the photovoltaic concentrator system with existing active and passive solar heating and cooling systems. The experiment represents remote installations of moderate size where the true cost of utility power is high due to transmission line construction in rough terrain. A description of the overall experiment concept is presented along with a description of the photovoltaic concentrator system, and results of system studies. (Author)

**A79-51768** **Hybrid alternate energy system.** P. E. Payne and J. L. Sheehan (BDM Corp., Las Vegas, Nev.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 251-254.

The hybrid combination of photovoltaic (P/V) systems and Wind Energy Conversion Systems (WECS) which forms a Hybrid Alternate Energy System (HAES) increases overall energy output and decreases energy storage requirements. Climatological data from various Nevada sites shows that cost-effective application of HAES at remote locations improves the utilization of the solar energy resource. The climatology intuitively leads desert dwellers to the conclusion that the wind often blows at night when the sun doesn't shine and the sun often shines brightly when the desert is still during the day. The design studies performed have been for remote locations for independent and utility back-up HAES applications for independent and utility back up HAES applications. The applications so far have been for remote desert communications, ranches, and remote equipment. The data taken predicts an overall system cost improvement in the range of 10% to 40%. The driving considerations are load profile, peak demand, back-up power, low maintenance, costs, and power management. (Author)

**A79-51769** **A combined photovoltaic/thermal electric central power plant.** D. F. Gluck (Aerospace Corp., El Segundo, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 255-260. 18 refs.

A preliminary design and performance evaluation of the subject power plant has been completed. DC energy is produced by boiling-water-cooled gallium arsenide solar cells covering a central receiver illuminated by a heliostat field with a concentration ratio of

one thousand The steam is used to power a low pressure turbine-generator, with the exhaust steam directly condensed in a dry air heat exchanger For the case of no energy storage, the heat exchanger size, air mass flux, turbine design temperature, and heliostat area were optimized resulting in a power plant with leveled bus bar energy cost (BBEC) of 70 mills/kWh at a plant capacity factor (PCF) of 0.30 Although PCF was increased beyond 0.30, in no case was BBEC reduced below 70 mills/kWh through the use of hot water thermal energy storage A comparison of this combined power plant with a photovoltaic plant with cooler solar cells showed the BBEC of the combined power plant to be 9% lower (Author)

**A79-51770 Application of a GaAs photovoltaic solar system in a utility substation** H J R Maget (Varian Associates, Palo Alto, Calif ) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 261-263 Research supported by the U S Department of Energy

A 50 kWp photovoltaic solar system has been designed to operate in parallel with a major utility substation An array efficiency of 15% is predicted, based on a solar concentration ratio of 400, high efficiency GaAs solar cells and a design aimed at maximum solar to ac energy conversion Unique high transmission Fresnel lenses, coupled with low energy consuming tracking and thermal subsystems allow to achieve these high system efficiencies The solar system, designed to deliver utility power only under conditions of insolation, consists of five subsystems collector, structure, thermal, power conditioning and data acquisition The design focuses attention on key system elements such as sun tracking, solar energy conversion, heat rejection and utility interface Details of the various subsystems, including surface preparation, shadowing, utility interface with a 21 kV transmission line, etc., will be presented, as well as the environmental, architectural and application problems associated with the location of the site in a densely populated residential area (Author)

**A79-51771 The desiccant/rock bed method of solar cooling with air collectors** D B Meredith (Pennsylvania State University, Uniontown, Pa.) and P J Wilbur (Colorado State University, Fort Collins, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 274-277 7 refs

A method of cooling buildings with solar energy is presented that incorporates a fixed desiccant bed, an evaporative cooler, associated controls and dampers, and conventional components and controls of a solar air heating system All components are commercially available items and the three heating modes (direct heating with solar, solar heat to storage, and heating from storage) remain unchanged The three additional operating modes pertaining to cooling (air conditioning, solar regeneration of the desiccant, and night regeneration of the rock bed) have been added To investigate the thermal performance of the system under typical weather and insolation conditions, a transient simulation model was constructed using TRNSYS The operating parameters assumed in the model are representative of the building and solar heating system of Solar House II at Colorado State University The hourly weather values assumed were for a summer season in Washington, D C The predicted operating characteristics, thermal coefficient of performance and electrical Energy Efficiency Ratio (EER) are discussed (Author)

**A79-51772 Analysis of the Photosynthesis Energy Factory as an integrated bioconversion system** M D Fraser, J F Henry, L C Borghi, and N J Barbera (Intertechnology/Solar Corp., Warren, Va.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 279-284 20 refs Contracts No EX-76 C-01-2548, No ET 78-C-01-3024

A Photosynthesis Energy Factory (PEF) is an integrated bioconversion system consisting of a dry-land Energy Plantation, a wood fired power plant, and a wetlands biological wastewater treatment system, such as an algae pond Products of a PEF are electricity from the power plant, synthetic natural gas from digestion of the wetlands biomass, and reclaimed wastewater The possible advantages are that effluents and by-products from one system part can be beneficially used by other parts, leading to increased energy conversion and resource recovery at lower costs In the initial study a general technoeconomic model was used to investigate possible interactions between the various subsystems In a second project the PEF model has been expanded and generalized by analyzing possible model improvements in the areas of materials transportation, water and nutrient balances, other types of wetlands biological systems, and improvements in wood-fired combustion systems Direct application of municipal wastewater to a dry land Energy Plantation has been analyzed, also Potential sites for PEF systems will be evaluated with the improved technoeconomic model (Author)

**A79-51773 Cogeneration with digester gas** J D Eppich, G M Adams, W E Garrison, and J C Gratteau (Los Angeles County, County Sanitation Districts, Whittier, Calif ) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 291-294

The current electrical power demands at the County Sanitation Districts of Los Angeles County Joint Water Pollution Control Plant (JWPCP) will triple with the addition of Federally mandated secondary treatment facilities The paper describes the power demands and the proposed cogeneration facilities In light of the stringent California air emission rules and economic considerations, combined cycle turbines, using pretreated digester gas as fuel, were selected as the prime movers for the cogeneration facilities The power train includes gas pretreatment system, gas turbine(s), heat recovery steam generator(s), and steam turbine(s) The proposed facility will generate approximately 14 MW from 143 MMBTUH after extracting steam for process heating requirements With the construction of this cogeneration facility, the overall thermal efficiency of the JWPCP should increase from less than 25 percent to greater than 60 percent (Author)

**A79-51774 Which alcohol fuel for Brasil - Methanol or ethanol** A V Carvalho, Jr., V Yang, and S C Trindade (Centro de Tecnologia Promon, Rio de Janeiro, Brazil) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 295-300 13 refs

This paper is an updated account of the achievements of the Brazilian National Alcohol Program and of the recently proposed program on methanol from wood (eucalyptus) Both programs aim at production and utilization of alcohol fuels Production, utilization and process considerations of both methanol and ethanol are presented Alcohols are still more expensive than petroleum fuels but provide more social benefits than imported energy (Author)

**A79-51775 Improving octane values of unleaded gasoline via gasohol** P Jawetz In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 301, 302 7 refs

Gasohol is defined as a mixture of 10% ethyl alcohol and 90% gasoline This may not be the most favorable composition and we use it as it presents mathematical simplifications in our calculations The requirements of the United States in what concerns motor vehicle fuels are (1) to boost the octane rating of regular unleaded gasoline by 3 points, (2) to keep the price differential between unleaded and leaded gasoline at no more than 3 cents/gallon and (3) to use renewable resources It will be shown that gasohol answers favorably these needs A series of utility factors will be developed and it will be

shown that one BTU of ethanol replaces 3.6 BTUs of petroleum when viewing the ethanol as an octane boosting additive (Author)

**A79-51776**      **Operation and analysis of a vertical axis wind turbine** S. J. Wake (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.), H. R. Braun (Defence Research Establishment, Ottawa, Canada), and D. J. Bristow (Canadian Forces, Borden, Ontario, Canada) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 303-307. 5 refs.

A 15' prototype Vertical Axis Wind Turbine (VAWT) located at the Defence Research Establishment Ottawa (DREO) has been monitored for three years. The turbine is used in combination with storage batteries to drive a continuous 60 W load. This system, the failures and modifications, are described. A computer simulation of the VAWT/battery storage system is discussed in relation to actual DREO site data. As an example, temperature and wind data from a weather station at Alert Northwest Territories are used to illustrate how the program might be utilized to assess the suitability of the system in another location (Author)

**A79-51777**      **Design and performance of bicycle wind turbine rotors** W. M. Mansour and M. H. Hirata (Rio de Janeiro, Universidade Federal, Rio de Janeiro, Brazil) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 308-311. Research supported by ELETROBRAS

A new arrangement of the spokes is presented and compared with the currently available bicycle rotors. The new arrangement alleviates the problems existing in the present design. A stress and aerodynamic assessment is fully developed for the new configuration. The bicycle rotor is to operate on a vertical-axis machine. The wind-deflector is designed and tested in the wind tunnel. Sample results are presented with an overall assessment of the performance. Qualitative tuft-tests show the existence of a back flow which enhances the performance (Author)

**A79-51778**      **The application of wind energy to a system with an inherent energy storage medium** T. Kobylarz and A. Al-Shehri (Petroleum and Minerals University, Dhahran, Saudi Arabia) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 312-318. 18 refs.

As is the case for other types of solar energy, economics have severely limited the exploitation of wind energy to a few special situations. Thus a tremendous energy source is wasted. One of the most costly aspects of a wind energy system is that of energy storage. It is therefore suggested that wind energy be utilized by systems having an inherent storage medium. One such system is studied in this paper. This is a chlorine and caustic soda production facility from the electrolysis of brine. By using wind speed data for Dhahran, Saudi Arabia, and published data for the system components, yields of chemicals and for power are predicted (Author)

**A79-51779**      **Assessment of wind energy systems in a utility framework** S. L. Macklis (General Electric Co., Valley Forge, Pa.) and J. L. Oplinger (General Electric Co., Electric Utility Systems Engineering Dept., Schenectady, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 319-324. Research sponsored by the Electric Power Research Institute

This paper presents studies of the technical and economic aspects of wind energy use in a utility grid. The first project, Requirements Assessment of Wind Energy Systems, concentrated on the methods for assessing the benefits and possible difficulties of wind energy application without concern for siting or distribution of

the wind energy system in the grid. The second project, Assessment of Distributed Wind Power Systems, is concerned with the impact of dispersed vs. centralized wind power facilities and the comparison of small vs. large machines. Wind characterization for specific sites, the interface with the utility in terms of matching load and wind available energy profiles, and analysis of the utility system using wind energy are discussed. Results are shown in terms of fuel savings and economic benefit for different utilities and wind regimes. A. T.

**A79-51780 \***      **Control and stabilization of the DOE/NASA Mod-1 two megawatt wind turbine generator** R. S. Barton (General Electric Co., King of Prussia, Pa.), C. E. J. Bowler, and R. J. Piwko (General Electric Co., Electric Utility Systems Engineering Dept., Schenectady, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 325-330. 5 refs. Research supported by the U.S. Department of Energy, Contract No. NAS3-20058

This paper describes the controls design, performance simulation process and specialized dynamic considerations for the DOE/NASA Mod-1 wind turbine generator (WTG). It shows controls, structural and utility interface considerations of the wind turbine generator and shows how a wind turbine generator can be integrated with a synchronous power system. Differences with respect to fossil or hydro generation and their implications are vital to long-term WTG reliability and availability and acceptance by utilities and consumers. The paper describes the control performance requirements to provide stable pitch and excitation control with drivetrain torsional dynamics, and the control of power swing stability and utility feeder voltage due to wind gusts (Author)

**A79-51781**      **A low cost composite blade for a 300 foot diameter wind turbine** M. L. White and W. D. Weigel (Kaman Aerospace Corp., Bloomfield, Conn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 331-336. 11 refs.

A prototype composite blade for a 300 foot diameter horizontal axis wind turbine has been designed, fabricated and successfully subjected to structural and natural frequency tests. The blade consists of a filament wound E-glass/epoxy leading edge spar, an E-glass/polyester trailing edge spline fabricated from pultrusions, sandwich panels constructed of phenolic resin impregnated kraft paper honeycomb faced with glass cloth/epoxy, and a steel hub adapter. Composite components are joined by epoxy adhesive bonding, and the hub adapter is mechanically fastened to the spar and spline. Total weight of the blade is approximately 36,000 pounds, of which almost 26,000 pounds are composite structure and the remainder the steel adapter. A woven roving material having almost all fibers oriented transverse to its length was used to wind the 19,000 pound, monocoque shell spar, producing an efficient structure with approximately 90 percent spanwise fiber orientation and a structural taper in overall dimensions and wall thickness (Author)

**A79-51782**      **Prediction of vehicle performance and its sensitivity to component improvements - Application to electric and H<sub>2</sub>-fueled vehicles** R. F. McAlevy, III (Stevens Institute of Technology, Hoboken, N.J.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1      Washington, D.C., American Chemical Society, 1979, p. 337-342. 8 refs.

Simple, algebraic equations were used to relate vehicle mass, WT, and energy consumption, C, to parameters describing vehicle components characteristics. By differentiation, the sensitivity of WT and C to component improvements was determined and used to formulate a rational R & D investment policy. For H<sub>2</sub> fueled vehicles and electric vehicles, EV's, R & D investment in improving vehicle energy-storage device was predicted to produce greater decreases in WT and C than investment in the power train. Using a published forecast of component characteristics, WT and C for both kinds of

vehicles were projected into future time-frames. Numerical results are presented (Author)

**A79-51783 Regenerative flywheel energy storage system**  
E L Lustenader, I H Edelfelt, D W Jones, A B. Plunkett, E Richter, and F G Turnbull (General Electric Co., Schenectady, NY) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 343-351 9 refs Contract No EY-76-C-02-4010

This paper describes the status of a program to develop and evaluate a regenerative flywheel energy storage system. The system has been designed for a battery/flywheel electric vehicle in the 3000 pound class. Laboratory tests will simulate this electric vehicle operating over the SAE J227a Schedule D driving cycle. The range improvement attributed to the use of the flywheel will be established. The flywheel energy storage system will consist of a solid rotor, synchronous inductor-type flywheel drive machine electrically coupled to a DC battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. The laboratory simulation will include a battery bank, propulsion motor coupled to a flywheel and the flywheel energy storage system comprised of the water/flywheel unit, the load commutated inverter and its control (Author)

**A79-51784 High-energy-density flywheel** D L Satchwell (AirResearch Manufacturing Company of California, Torrance, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 352-356 Research supported by the U S Department of Energy

The design and fabrication of a flywheel rotor with an energy density of 80 whr/kg is described. The design uses a multi-ring, S glass and Kevlar composite rim mounted on a graphite composite spoked hub. Graphite composite material reduces the rotor assembly weight, increasing the energy density, and graphite epoxy material was selected for the hub because of its high modulus of elasticity, light weight, and high ultimate flexural strength. The hub consists of multiple slats alternately bonded together to form a four-spoke hub of rigid cruciform shape. Hubs were compression tested and two hubs were cycled to an increased stress level equivalent to a full-life test A T

**A79-51785 Development of a low loss flywheel magnetic bearing** D Eisenhaure, G Oberbeck, and J Downer (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 357-362 6 refs.

This paper reviews the development of a flywheel magnetic bearing. The objective of this program is to demonstrate the economic and engineering advantages of ultralow loss magnetic bearings by analyzing a model flywheel suspension. In addition, performance equations are being developed for the flywheel suspension, allowing it to be scaled for flywheels of various sizes and applications. Suspension alternatives such as conventional gas and ball bearings, the magnetic suspension loss analysis, magnetic design, dynamics, and the control system are discussed. It was concluded that the loss, reliability, and cost of magnetic bearings for an energy storage flywheel make it superior to conventional bearings for large scale, long storage time applications as utility peak shaving A T

**A79-51786 Performance of retainerless bearings for flywheels** E P Kingsbury and D Eisenhaure (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C.,

American Chemical Society, 1979, p 363-367 Research supported by the U S Department of Energy

This paper summarizes the analysis and test of losses in ball bearings for vehicular flywheel applications. Particular emphasis was placed on the full complement retainerless concept which prior research indicated had low loss and long life at high speed in a vacuum environment. Three sizes of standard bearings were modified to the full complement retainerless configuration. These modified bearings and several sets of standard retainer bearings were tested during the contract. Friction losses were obtained for a variety of radial and axial loads in vacuum and the results integrated into a performance prediction equation. The latter was formulated by combining the experimental data base with a theoretically derived model and allows the optimization of future ball bearing configurations for vehicular flywheel systems (Author)

**A79-51787 Design of flywheel rotors utilizing cellulosic materials** D L Hagen, A G Erdman, and D A Frohrib (Minnesota, University, Minneapolis, Minn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., Aug 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 368-373 20 refs Research supported by the Minnesota Energy Agency, U S Department of Energy, and U S Navy

Natural cellulosic materials have been shown to have moderate specific energy storage potentials. The low material and assembly costs suggest that cellulosic rotors may be economically competitive in stationary flywheel storage applications where volume and total mass are not primary considerations. One to two ton pseudoisotropic plywood rotors are feasible and would cost \$50/MJ. Compound rotors of hose wire or E glass wound around plywood cores are promising. The working strengths of vacuum dried wood are being measured as a function of the cyclic fatigue and stress in a rotor. Methods are being developed to attach hubs, balance rotors and resolve problems of outgassing and cracking during evacuation. Fundamental rotor vibrational frequencies are compared with the operating speeds as functions of the dimensions and material properties of the rotor and shaft with elastomeric pads between (Author)

**A79-51788 Low cost flywheel energy storage system demonstration** D W Rabenhorst (Johns Hopkins University, Laurel, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 374-378

This paper presents a description of the low cost flywheel energy storage system demonstration program. The applicable flywheel configurations including pseudo-isotropic and bare filament, low cost materials such as steel wire and vinyl-impregnated fiberglass, low loss, long life bearing investigations, and the flywheel energy storage demonstration units were described. It was concluded that a very low flywheel production cost of \$50 per kW hr can be achieved with several materials, the filament configuration is best, magnetically load relieved mechanical bearings are promising for the low cost, long life system, and a flywheel energy storage system is feasible for home applications A T

**A79-51789 Novel flywheel energy storage system** R Chicurel (Universidad Nacional Autonoma de Mexico, Mexico City, Mexico) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 379-382 7 refs

This report describes a kinetic energy storage system in which a flywheel rotates inside an evacuated casing. Both the flywheel and the casing rotate about a horizontal axis, but the speed of the second is much lower than that of the first. This is governed by a fixed ratio mechanical drive also contained within the casing itself. The reaction torque required by the drive is provided by the action of gravity on a reaction member which is mounted in the manner of a pendulum.

Three versions of the system are proposed. A prototype of one of these with a capacity of 25 watt-hours is being built (Author)

**A79-51790** **Energy storage and conversion in conjunction with photovoltaic energy systems.** A W Johnson, R L McCarthy (General Electric Co., Valley Forge, Pa.), and G C Chang (U.S. Department of Energy, Washington, D C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 383-388

A recently completed study investigated various possible energy storage media and concepts for use with photovoltaic energy conversion systems sized for various utility, residential, and intermediate loads. Increases in energy capture attributable to the use of storage were analyzed for conditions found at widely-separated geographical locations in the United States. A separate utility power pool simulation was run to correlate results in the utility portion of the study. The study concluded that utility energy storage should be applied on a systemwide basis, not dedicated exclusively to a photovoltaic system. It also concluded that further increases in energy costs must occur before residential and intermediate applications become generally attractive for the types of storage studied. No single energy storage concept was found to be satisfactory for all cases, although battery storage was the most generally attractive for the near term (Author)

**A79-51791** **Flywheel energy storage interface unit for photovoltaic applications.** A R Millner and R D. Hay (MIT, Lexington, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 389-394. Research sponsored by the U S Department of Energy

A flywheel energy storage and conversion system has been designed and a prototype is now being built at Massachusetts Institute of Technology/Lincoln Laboratory for the U S Department of Energy. It is intended to serve as an interface between a solar photovoltaic array and an ac load, providing output waveform regulation as well as energy storage. Important features include magnetic bearings, an ironless armature motor generator and a low cost flywheel rotor. This paper describes the system design and prototype characteristics and includes a preliminary economic analysis (Author)

**A79-51792** **Residential flywheel with turbine supply T W Place** (AirResearch Manufacturing Company of California, Torrance, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 395-398

A flywheel system that stores energy from a wind turbine source and converts the energy to a 60-Hz, 220-V output for residential use is described. The typical residence has a 1500-sq ft floor area, with a maximum power level of 5 kW. The flywheel system was defined in a study to determine the cost benefits of storing wind energy in a flywheel and using it on a demand basis. The systems and the flywheel rotor materials that offer the greatest promise in reducing initial costs were examined. The paper describes the progress to date on this program and the work planned to complete the study (Author)

**A79-51793** **Underground pumped hydro storage - An evaluation of the concept.** J J Fairfield (Chas T Main, Inc., Boston, Mass.), G C Chang (U S Department of Energy, Washington, D C.), and N J Jacobs (U S Bureau of Reclamation, Denver, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 399-404. Research sponsored by the U S Bureau of Reclamation and U S Department of Energy

A review of the present state-of-the-art of underground hydroelectric pumped storage (UHPS) and an evaluation of the technical feasibility and economic viability of the concept are presented. Design criteria selected are 2000 MW capacity, 1200 m (4000 ft) head, and 10 hour storage. Three potential schemes were identified. Suitable sites for UHPS are available within most of the electric power systems of this country. A UHPS plant significantly reduces environmental factors of a conventional pumped storage project. Capital cost estimates of three schemes vary from \$318/kW to \$346/kW, excluding AFDC. UHPS offers substantial savings in investment costs compared to coal fired cycling plants and in system production costs compared to gas turbine units. Present worth system analysis favors the use of UHPS compared to alternative systems considering operating cost plus alternative unit investment cost (Author)

**A79-51794** **Turbomachinery options for an underground pumped hydroelectric storage plant.** C A Blomquist, S W Tam, and A A Frigo (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 405-413. 16 refs. Research supported by the U S Department of Energy

Various turbomachinery options for underground pumped hydroelectric storage (UPHS) plants are reviewed. Current technology indicates that the maximum head for single-stage, reversible, Francis-type pump turbines is 625 m, for separate, single stage, Francis-type turbines and multistage pumps, 672 m, for tandem units consisting of separate multistage impulse turbines and multistage pumps, 1440 m, and for multistage, reversible, ungated Francis type pump turbines, 1290 m. Engineering design studies conducted for Argonne National Laboratory indicated that heads for the single stage reversible units could be extended to 1000 m, developing 500-MW output per unit. The studies also indicated that two-stage, reversible Francis-type pump turbines with adjustable wicker gates could be developed for power outputs up to 500 MW at operating heads as high as 1500 m. Results of these studies, including performance and design data, are presented (Author)

**A79-51795** **Pumped storage battery with 100 percent efficiency.** H Kinno (Tokushima University, Tokushima, Japan.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 414-418

A design for improving the efficiency in pumped storage batteries up to 100% by harnessing renewable tidal potential is presented. The procedure involves replacing the head gap between the pump and the turbine by a tidal potential. The calculations involving power pump and turbine equations are examined in detail. Attention is given to the structure of the pumped storage battery, harnessing tidal potential, by investigating a tidal and machine model and the numerical analysis of the data. C F W

**A79-51796** **Coal-fired fluid bed compressed air energy storage power plants - A preliminary technical assessment.** R D Lessard, A J Giramonti, and R L Sadala (United Technologies Research Center, East Hartford, Conn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 419-425. 9 refs

**A79-51797** **Incremental cost analysis for advanced compressed air energy storage concepts.** C A Knutsen (Knutsen Research Services, Bothell, Wash.), M A McKinnon, and S C Schulte (Battelle Pacific Northwest Laboratories, Richland, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 426-428. 6 refs

The paper describes under what conditions the compressed air energy storage (CAES) concepts, that minimize or eliminate the use of petroleum-derived fuels by storing the compression heat in thermal energy storage (TES) chambers, are economically competitive with conventional oil-fired CAES systems. The study compares the levelized costs of electricity of two advanced CAES systems - the hybrid CAES system with one stage of TES, and an unfired CAES system with two stages of TES - to the cost for a conventional CAES system in 1985 price levels. Attention is given to the cost analysis for the storage concepts as well as capital equipment and energy use comparison. It is determined that the TES systems use less turbine fuel, have higher capital costs, and use more compression energy.

C F W

**A79-51798 On the formulation of stability and design criteria for compressed air energy storage in hard rock caverns** P F Gnirk and A F Fossum (RE/SPEC, Inc., Rapid City, S. Dak.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 429-440. 27 refs.

The primary objectives of this paper involve formulation of appropriate stability and design criteria for the construction, operational, and decommissioning phases of CAES caverns in hard rock, presentation of the elements of a numerical simulation model for cavern stability assessment, and discussion of the concept of failure probability assessment for CAES caverns. The basic notions of stability and instability are established, and the relevant phenomenological modes of cavern instability identified in conjunction with their corresponding constitutive laws. Precedent design and stability considerations are briefly addressed in the context of overall application to underground cavern development and use. Cavern shakedown for enhancement of cavern stability and the use of probabilistic design procedures are two important features of this paper. (Author)

**A79-51799 Analysis of mass cycling in porous rock reservoirs for compressed air energy storage** L E Wiles (Battelle Pacific Northwest Laboratories, Richland, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 441-445. Research sponsored by the U.S. Department of Energy.

The analysis of the hydrodynamic and thermodynamic response to moist air cycling in a compressed air energy storage (CAES) porous rock reservoir is described. The analysis is based upon the numerical solution of the appropriate set of conservation equations, which define the pressure and thermal behavior of the reservoir. The sensitivity of the performance of the reservoir is evaluated with respect to reservoir parameters, which include reservoir geometry, reservoir material properties, residual water content, and operating conditions. The pressure response of the reservoir is evaluated by consideration of those parameters that define the flow resistance and the air storage volume. The potential impact of residual water on both the pressure and thermal response is evaluated. Results of the analysis are interpreted to characterize the behavior of the reservoir under conditions of daily air cycling. The results also provide design guidelines for the efficient and stable operation of the reservoir. (Author)

**A79-51800 Geologic issues related to underground pumped hydroelectric and compressed air energy storage** W F Adolphson, J S Mahan, E M Schmid, and K D Weinstein (Booz, Allen and Hamilton, Inc., Bethesda, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 452-454. 22 refs.

Analysis of the geologic issues related to compressed air energy storage (CAES) and underground pumped hydroelectric storage (UPHS) systems demonstrated that geologic conditions will have a

very significant impact on site selection, design, construction, and cost of these two systems. While CAES and UPHS have some common elements, the environments for which each is suitable are very different. Preliminary geologic investigations have indicated the existence of suitable sites for the construction of CAES chambers in three storage media over broad geographic areas of the United States. These include salt deposits, competent rock, and aquifers. Favorable locations for UPHS can be found in many competent rock media. While it may be generally concluded that there are no overall identifiable geological conditions that will prevent the development of either CAES or UPHS, geologic conditions may restrict or prevent development at specific sites. (Author)

**A79-51801 Study of turbomachinery options for compressed air energy storage plants** G T Kartsounes and C S Kim (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 455-458. 9 refs. Research supported by the U.S. Department of Energy.

A study of possible turbomachinery options for compressed air energy storage (CAES) plants is presented. Particular emphasis is placed on the turbine system of the plant. Plant performance is presented in terms of five parameters: (1) specific air flow rate, (2) heat rate, (3) storage volume, (4) compression rate, and (5) overall plant efficiency. It is concluded that optimum performance results from high storage pressure and high inlet gas temperatures to the turbines. The economic analysis, however, illustrates that minimum cost does not necessarily correspond to optimum plant performance. It is shown that presently available conventional turbomachinery with proven reliability is competitive with advanced concepts. (MEP)

**A79-51802 Electric utility applications of thermal energy storage and transport** W Hausz (General Electric Co., Santa Barbara, Calif.), R K Anand, and N LaMarche (General Electric Co., Schenectady, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 467-474. 6 refs.

The paper surveys applications of thermal energy storage (TES) to conventional light water reactor and high sulfur coal plants. Among the applications considered for thermal energy stored during off peak periods, are electric peak power generation, and thermal transport to serve process heat demands and district heating systems. In addition, four conceptual designs as peaking power systems are covered, two of which are based on hot rock and oil as the dual storage media. The other two store high temperature water (HTW) under pressure. Finally, the transmission of thermal energy for up to 50 km is compared for HTW, hot oil, molten salt, and steam, over their applicable temperature ranges. (MEP)

**A79-51803 A thermal energy storage system for a Stirling engine powered highway vehicle** E D Waters, E W Saaski (Sigma Research, Inc., Richland, Wash.), and W R Martini (Martini Engineering, Richland, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p 475-480. 10 refs. U.S. Department of Energy Contract No. 31-109-38-3983.

The conceptual design of an automotive propulsion, thermal energy storage system has been developed that utilizes the sensible and latent heat of fusion of a molten fluoride salt. Electromagnetically pumped potassium serves in the vapor liquid heat transport system, and high-performance nonmetallic insulation is utilized to minimize energy loss. Engineering analyses are presented to substantiate adequate thermal and material performance to provide at least 161-km range for a 500-kg system, with power bursts in excess of 200-kW available. The thermal energy storage system is compared with advanced electrochemical storage devices. Preliminary production costs and life-cycle costs are presented, and safety and other public acceptance issues are reviewed. (Author)

**A79-51804 Superconducting Magnetic Energy Storage for electric power system stabilization.** R D Turner (California, University, Los Alamos, N Mex) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 494-499 10 refs.

A Superconducting Magnetic Energy Storage (SMES) system is being developed at the Los Alamos Scientific Laboratory (LASL) for a dynamic stabilizer to be installed in the Bonneville Power Administration (BPA) power system at Tacoma, Washington, by 1982. This unit will be an alternate stabilization method to the dc modulator now used to stabilize the 900 mile, ac intertie between BPA and Southern California. The generation control systems' response to the constantly occurring, small-load and voltage changes can result in negatively damped, low frequency power oscillations. The SMES dynamic stabilizer design is presented herein, and status information is given about the superconducting coil, the converter, and other components of the SMES dynamic stabilizer. (Author)

**A79-51805 Methanol based heat pumps for storage of solar thermal energy.** P O Offenhardt and F C Brown (EIC Corp., Newton, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 507-509. Research supported by the U.S. Department of Energy.

The thermochemical cycle for a solar thermal storage system based on the reaction of  $\text{CaCl}_2$  and  $\text{CH}_3\text{OH}$  vapor is described. This cycle is capable of pumping heat for solar air conditioning at a COP of 0.6, or for solar space and domestic water heating at a COP of 1.6. The equilibrium and kinetics of the  $\text{CaCl}_2/\text{CH}_3\text{OH}$  system are described, along with details of heat transfer measurements made in a small (1500 Btu) energy storage test unit. Finally, the reactor design of the energy storage unit is presented. The system requires a solar input at ca. 130 C, and can pump heat from an ambient source below 0 C to indoor air heating ducts at 43 C. Because the heat pump cycle is thermally activated, requirements for electric power are minimal. (Author)

**A79-51806 Development and testing of the sulfuric acid-water chemical heat pump/chemical energy storage system.** C C Hiller (Sandia Laboratories, Livermore, Calif.) and E C Clark (Rocket Research Co., Redmond, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 510-515 14 refs. Research supported by the U.S. Department of Energy.

The sulfuric acid system is very attractive for solar heating and cooling and other applications because of extremely high energy storage densities, low chemical and storage costs, and low solar collector field costs. Attention is given to principles of operation and preliminary economics. Testing of a prototype unit of nominal 25,000 to 35,000 Btu/hr (7 to 10 KW) capacity is covered, noting that engineering model tests have demonstrated the technical feasibility of the concept and have verified the analytical models used. M E P.

**A79-51807 Hybrid thermal storage subroutine for transient simulation.** E P French (Rockwell International Corp., Satellite Systems Div., Seal Beach, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 516-520. Contract No. EG-77 C-02-4480.

A FORTRAN subroutine models a hybrid thermal storage system consisting of a water tank surrounded by a rock bed. The subroutine conforms to the requirements of the transient simulation code TRNSYS and may be used to evaluate the thermal performance of such systems. Heat flow within the storage system is modeled by a thermal network consisting of N rock bed nodes and N-4 water tank

nodes. The subroutine evaluates the first time-derivatives of the node temperatures, taking into account internode conduction, losses to the environment, and convection to the air and water flowing through the system. Results suggest that numerically stable transient calculations can be made with acceptable computation costs.

(Author)

**A79-51808 A simplified algorithm for the evaluation of hybrid thermal storage with water systems.** M P Moriarty (Rockwell International Corp., Canoga Park, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 521-527 23 refs. Research supported by the U.S. Department of Energy.

An analytical model, based on an extension of the water tank model developed by Gutierrez, is developed to compute the performance of hybrid thermal storage with water systems. The transient heat balance equations for each of nine bed nodes result in a set of 14 linear differential equations that must be integrated timewise simultaneously. The integration is accomplished by means of a backward difference technique and a compact elimination method that avoids the numerical instability problems often encountered with conventional integration schemes. The storage code is used in conjunction with a simplified systems model to analyze the performance of various configurations of storage systems in solar heating systems. It is shown that for systems of equivalent thermal mass, a metal walled water tank in a rock bed offers significant performance gains over heavily insulated above-ground tanks, buried uninsulated tanks, and combined heat exchanger-below grade tanks. M E P.

**A79-51809 \* # Commercial phosphoric acid fuel cell system technology development.** P R Prokopius, M Warshay, S N Simons, and R B King (NASA, Lewis Research Center, Fuel Cell Projects Office, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 538-543 6 refs.

A review of the current commercial phosphoric acid fuel cell system technology development efforts is presented. In both the electric utility and on site integrated energy system applications, reducing cost and increasing reliability are the technology drivers at this time. The longstanding barrier to the attainment of these goals, which manifests itself in a number of ways, has been materials. The differences in approach among the three major participants (United Technologies Corporation (UTC), Westinghouse Electric Corporation/Energy Research Corporation (ERC), and Engelhard Industries) and their unique technological features, including electrodes, matrices, intercell cooling, bipolar/separator plates, electrolyte management, fuel selection and system design philosophy are discussed. (Author)

**A79-51810 \* # The role of fuel cells in NASA's space power systems.** J F Been (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 544-549 11 refs.

The advances in fuel cell technology which have expanded the capabilities of the fuel cell from that of power generation to include energy storage also expanded its potential role in space power systems. This paper presents a brief evolutionary history of the fuel cell technology and compares this with NASA's increasing space power requirements. The role of fuel cells is put in perspective with other energy storage systems applicable for space using such criteria as type of mission, weight, reliability, costs, etc. Potential applications of space fuel cells with projected technology advances are examined. (Author)

**A79-51811 A 5-MW acid fuel cell power plant featuring high temperature steam reforming of No. 2 fuel combined with**



**autothermal reforming.** K K Ushiba, I Mahawili (Catalytica Associates, Inc., Palo Alto, Calif.), and T H Tio In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 550-553 14 refs Research supported by the Electric Power Institute

A conceptual 5-MW phosphoric acid fuel cell power plant featuring high temperature steam reforming combined with autothermal reforming is evaluated Using a No 2 fuel oil, this power plant can potentially achieve a 9000 Btu/kwh heat rate without a bottoming cycle The power plant is also capable of exporting about 7000 lb/hr of a low pressure steam The autothermal unit is used to complete the reforming conversion of the fuel and therefore it is a key factor in achieving the high thermal efficiency for this power plant (Author)

**A79-51812 Scale-up of phosphoric acid fuel cells** L. G. Christner, H. C. Maru, C. V. Chi, S. R. Perkari, and M. A. Lambrecht (Energy Research Corp., Danbury, Conn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 554-558 6 refs Contract No EC-77-C-03-1404

Development of phosphoric acid fuel cell power-plants has progressed significantly at the Energy Research Corporation. This progress has required development of both the component materials and the production techniques. Scale up of cells from laboratory size 2 in x 2 in cells to 80-cell 5 in x 5 in stacks has been successful and further scale up for stationary 100 to 1000kW powerplants is in progress Although any optimization of scale up size depends on some basic assumptions, the present analysis is used for guiding the development effort Considerations of reliability, simplicity, and cost indicated that a 1.25 sq ft cell with 0.75g sq ft of platinum and a DIGAS cooling system would be adequate for on-site integrated energy systems (Author)

**A79-51813 Tungsten carbide/platinum fuel cell with phosphoric acid as electrolyte.** R. Fleischmann, H. Bohm, and J. Heffler (Telefunken AG, Frankfurt am Main, West Germany) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 559-562 7 refs

A fuel cell system operating with tungsten carbide anodes and carbon/platinum cathodes can convert crude gas with a high amount of carbon monoxide The report describes the complete energy generator, starting with the methanol crackreaction up to the steering of fuel consumption and working temperature Some efforts have been made to improve the anodes and the cathodes related to crude gas and air operation Performance data are given for 40 - cell stacks (Author)

**A79-51814 Molten carbonate fuel cell systems development program.** S. S. Borys and J. P. Ackerman (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 563-567

The paper surveys the molten carbonate fuel cell (MCFC) systems development program Attention is given to cell operation and components, as well as the current status of cell development Goals discussed include those for performance, lifetime, contaminant tolerance and stack costs The DOE MCFC systems development program objectives and a powerplant description are given Also considered are the cleanup subsystem, the power processing subsystem, and different development phases such as technology and engineering development In addition, the program schedule and milestones are discussed M E P

**A79-51815 Solid electrolyte fuel cell for electric utility power generation.** S. Srinivasan and H. S. Isaacs (Brookhaven National Laboratory, Upton, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 568-575 14 refs Research sponsored by the U S Department of Energy

It is shown that with the emphasis in the USA on coal as the primary fuel for the production of electrical power, solid electrolyte fuel cell power plants have the following potential advantages over phosphoric and molten carbonate fuel cell systems (1) higher energy conversion efficiency, (2) higher power densities, (3) better utilization of waste heat from the fuel cell for coal gasification, and (4) cooling water not required for fuel cell Attention is given to significant improvements in cell performance obtained with the thin film electrolyte construction After a systematic screening of candidates for interconnection materials, lanthanum chromite doped with magnesium and aluminum was shown to have the requisite properties. Finally, it is noted that the engineering development and demonstration of multi-megawatt size coal gasifier solid electrolyte fuel cell power may be expected in the 1990-2000 year time frame M E P

**A79-51816 Molten carbonate fuel cell based, coal fired power plants for electric power generation** T. L. Bonds, M. H. Dawes, and A. W. Schnacke. In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 576-578

The results of a broad scoping study are described, which was conducted to define an attractive configuration for an integrated molten carbonate fuel cell based power plant for electric power generation A coal pile to bus-bar efficiency of 50.5% is adopted and the resultant configuration concepts are discussed Attention is given to general plant requirements such as power level, fuel, site/characteristics and environmental considerations Also discussed are fuel cell operating conditions, carbon formation, fuel cell temperatures, equipment availability, and minimization of clean up system parasitic power and process steam The final configuration discussed includes an oxygen-blown Texaco gasifier feeding a Selexol cleanup system and a zinc oxide polisher following M E P

**A79-51817 Molten carbonate fuel cell performance model for cycle studies.** M. H. Dawes and L. W. Spradlin (General Electric Co., Energy Systems Programs Dept., Schenectady, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 583-585

The paper describes a model formulated to represent the performance of a molten carbonate fuel cell under various operating conditions. A fuel cell subsystem is described, noting that throughout this system, the model computes flow rates, heat fluxes, temperatures, and gas compositions as well as the fuel cell electric performance. The fuel cell model itself represents the electrochemical reactions, including important gas shift reactions and electrochemical performance Finally, model results are presented, and it is noted that the model has been used to investigate many plant cycle configurations and many subsystem configuration and operating modes M E P

**A79-51818 Effect of temperature and pressure on molten carbonate fuel cell fuels and performance.** K. W. Hahn, T. E. Tang, and E. H. Camara (Institute of Gas Technology, Chicago, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 586-589 Contract No EC-78-C-03-1735

The paper evaluates the effects of molten carbonate fuel cell operating temperature and pressure on fuel gas compositions and on fuel cell performance based on thermodynamic and experimental data It is shown that the optimum operating temperature was experimentally determined to be 650 C for cells assembled with the Li<sub>2</sub>CO<sub>3</sub>/K<sub>2</sub>CO<sub>3</sub> binary eutectic electrolyte, independent of fuel gas

and oxidant compositions. It is reported that cell performance increased beyond the predicted Nernst gains when the pressure was increased from 1 to 10 atm, while total performance gains were found to be proportioned to  $1/n$ . Contributions from other factors such as improved gas solubilities, mass transfer rates, and changes in meniscus shapes and locations appear to play a role in establishing cell performance at pressure. Finally, it is noted that increased operating pressure favors carbon deposition and methanation reactions. M E P

**A79-51820 The effect of mechanical energy storage systems on the characteristics of electric vehicles.** M W Schwartz (California, University, Livermore, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 617-621

Batteries for electric vehicle propulsion can be developed to effect trade-offs between short-term peak power capability and energy storage capacity. Such batteries in combination with a mechanical energy storage device can optimize both power and range capability of an electric vehicle. Equations are derived for determining the vehicle mass fraction of the mechanical energy storage system that is required to achieve a vehicle mass saving or increase in range. The extent to which mechanical energy storage systems can improve electric vehicle performance depends upon the battery type and the vehicle power/mass requirements. (Author)

**A79-51821 Advanced flywheel energy storage unit for a high power energy source for vehicular use.** A E Raynard (Air Research Manufacturing Company of California, Torrance, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 622-626

The design and development program of a flywheel energy storage unit (ESU) for vehicular use are surveyed. Attention is given to the fabrication and experimental determination of the performance of an advanced hermetically sealed ESU that has been sized for a typical 3000 pound curb weight vehicle. The flywheel can supply high power demands and can accept vehicle kinetic energy during braking (regeneration) at a rate limited only by the transmission power capability. It is noted that the principal goal of the development program is to provide decision making information regarding the benefits of a mechanical energy storage device, as it applies to vehicle fuel consumption or vehicle range. Finally, the testing and evaluation subtasks of the development program are covered. M E P

**A79-51825 # The Department of Energy electric vehicle battery program - An overview.** M J Katz and K W Klunder (U.S. Department of Energy, Washington, D C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 643-645

The paper surveys the Department of Energy electric vehicle battery program, noting that if the number of electric vehicles in use were to reach 15 million, the annual consumption of oil would be reduced by some 225 million barrels. Attention is given to the two segments that the program is divided into: the near term battery development, and advanced battery R&D. The former involves the development and engineering design of full size vehicle batteries (20-30 kWh) of three battery systems: nickel/zinc, nickel/iron, and improved lead acid. The latter involves such designs as the lithium/metal sulfide battery, the sodium/sulfur battery, the zinc/chlorine battery, and metal air batteries. M E P

**A79-51826 # Performance characteristics of nickel-zinc electric vehicle battery.** M Klein, A Charkey, H Vaidyanathan and S. Viswanathan (Energy Research Corp., Danbury, Conn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1

Washington, D C, American Chemical Society, 1979, p 646-650 U.S. Department of Energy Contract No 31-109-38-4248, Contract No W-31-109-eng-38

A vented prismatic cell of 250 Ah nominal capacity has been chosen as a baseline design for first generation vehicle and cell characterization experiments. Performance characteristics such as discharge capacity (and its dependence on temperature and rate, variation of cycle life with depth of discharge), thermal variations and cyclic behavior on a simulated J227aD discharge profile are presented. A 96 volt vehicle battery was fabricated and installed in a Jet Industries Electra-Van Model 500. Vehicle operating results are presented in terms of speed, acceleration, range and energy consumption. (Author)

**A79-51827 A comparison of metal-air batteries for electric vehicle propulsion.** W A Bryant and E S Buzzelli (Westinghouse Research and Development Center, Pittsburgh, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 651-653 15 refs. Research supported by the U.S. Department of Energy.

A comparison is made among four metal-air systems being considered for future use in commuter electric vehicles. The anode materials are lithium, aluminum, zinc and iron. The lithium-air system is still in an early stage of development. A proposed mechanically rechargeable aluminum-air system is potentially capable of superior performance but its relative cost of ownership and operation is expected to be high. Several slurry zinc air systems are being developed which avoid the traditional problems associated with the plate type zinc electrode. A fully-developed iron-air system, especially one equipped with a bifunctional air electrode, is expected to be low-weight and economical. (Author)

**A79-51828 Evaluation of battery performance using computer controlled test equipment.** G S Hartman and D L Beals (ESB Technology Co., Yardley, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 654-659 9 refs.

The paper reports on the testing of groups of lead acid batteries which involved charging and discharging at widely varying currents and at a series of temperatures. A brief description of the ANL/DOE ISOA battery development effort is presented. Attention is given to the initial experiment consisting of a total of 32 design variables involving 96 batteries. Discharges were performed at current values of 10, 40, 60, 80, 150, and 250 amperes at 25, 40, and 0 C. The design of the test equipment, its operational modes and typical data output in both graphic and tabular form is discussed in both battery and computer terms. Finally, it is concluded that a preliminary examination of the initial test data indicates that the techniques are adequate to handle the complexities of large scale testing of a substantial number of differing design lead acid batteries normally tested as a part of a major design and development program. M E P

**A79-51829 Advances in the development of Li-Al/FeS cells for electric-automobile batteries.** F J Martino, T W Olszanski, L G. Bartholme, E C Gay, and H Shimotake (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C, American Chemical Society, 1979, p 660-664 6 refs. Research sponsored by the U.S. Department of Energy.

Industrial contractors are currently developing the Mark IA Battery for Argonne National Laboratory using BN-fabric separator material in their multiplate cell. However, cost and weight restrictions imposed by future program goals (Mark II) may require a revision of their cell design to accommodate alternative separator materials. Recent advances at ANL have shown the feasibility of replacing BN fabric with BN felt or MgO powder in both bicell and multiplate cell configurations. This paper discusses the progress made, with emphasis on cell assembly and performance, as well as the problems associated with the development of these cells. (Author)

**A79-51830** A charging system for the LiAl/FeS electric vehicle battery W DeLuca, A Chilenskas, and F Hornstra (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 665-670 Research sponsored by the U.S. Department of Energy

The charging scheme selected for the EV battery application employs a current-controlled main charger and current bypass circuits which shunt charge current around individual cells for equalization. A proof-of-concept charging system has been built which accommodates batteries of up to six cells. Tests have been performed on both LiAl/FeS and lead-acid batteries. The system is described, operational data presented, and plans for a full-scale 26 kWh LiAl/FeS battery charging system outlined. This charging system, which incorporates electronic cell equalization, may offer advantages to other types of battery systems, such as (1) reduced generation of gases, (2) reduced water consumption, (3) cleaner battery containers, (4) reduced maintenance, and (5) increased battery life (Author)

**A79-51831** Multi-foil insulator container for electrical vehicle application of a lithium-aluminum/metal sulfide battery S Matsuda, G Miskolczy, F N Huffman (Thermo Electron Corp., Waltham, Mass.), K Gentry, R Hudson (Eagle-Picher Industries, Joplin, Mo.), W Eggert, and G Santos (Budd Technical Center, Fort Washington, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 671-675 U.S. Department of Energy Contract No 31-109-38-4123

**A79-51832** A zinc-bromine battery for energy storage R A Putt (Gould, Inc. Energy Research Laboratory, Rolling Meadows, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 683-690 5 refs

The battery comprises a cell stack of titanium electrodes and a DARAMIC microporous separator, a bromine storage device apart from the cell stack, and a plumbing network which circulates the electrolyte between the two. Testing of laboratory cells and batteries has shown this system to be capable of a high efficiency, a long cycle life, and the inherent reliability required for the utility application. Based on the results of a cost and design study, a large (100 MWh) utility battery would comprise an array of self-contained, truckable, 400 kWh modules, the cost of which, although high for the first design, is subject to considerable reduction via modifications (Author)

**A79-51833** Modeling of zinc-chloride batteries for electric vehicles. C H Chi, P Carr, and P C Symons (Energy Development Associates, Madison Heights, Mich.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 692-697 Research supported by the Energy Development Associates and U.S. Department of Energy

In this paper, modeling of battery designs for typical route vehicle missions and for random use in typical urban/suburban missions are presented from the standpoints of battery size, power characteristics, energy capacity, lifetime, and other performance requirements. The overall performance of the vehicle/battery combination is presented for the selected vehicle design. The sensitivities of battery characteristics and of battery component performances with regard to the mission requirements of electric vehicles are examined. A cost analysis for operating the vehicle and a safety and environmental study are discussed (Author)

**A79-51834** Dow sodium-sulfur battery for energy storage J N Anand (Dow Chemical Co., Walnut Creek, Calif.) In

Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 698-702

An advanced high temperature sodium-sulfur battery using hollow glass fibers as the electrolyte is being developed at Dow for potential load-levelling application by electric utilities and power intensive industries. The multiple fiber cell structure is being designed to have a two-way efficiency of 90%. The high electrolyte surface area and corresponding low current densities yield very fast charge and discharge capabilities. These characteristics also make these batteries suitable for usage in areas of electric vehicle and solar power generation. The battery uses abundant commercially available materials such as sodium, sulfur, glass, aluminum and steel. The fabrication process is quite simple and is potentially easy to scale-up. The cell economics are projected to be at a very favorable low cost of about \$31/KWH in terms of 1979 dollars (Author)

**A79-51835** Reproducibility and performance of large prototype Na/S cells. D W Bridges, D G Paquette (Ford Aerospace and Communications Corp., Newport Beach, Calif.), and R W Minck (Ford Aerospace and Communications Corp., Newport Beach, Calif., Ford Motor Co., Dearborn, Mich.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 703-709

Test results of twenty cells subjected to a 250-cycle endurance test are presented, noting that five ceased to function electrically before the end of the test. Fifteen survived the test while fourteen decreased in capacity less than ten percent. These cells contained beta-double prime-alumina solid-electrolyte tubes, 34 mm OD and 250 mm long. They were operated at 350 C, discharged at 89 mA/sq cm for 4 h and charged at 51 mA/sq cm for 7 h. It is concluded that the development of a Na/S cell has advanced sufficiently to enable the testing of rudimentary batteries. Finally, it is noted that improvements have been made in the glass seal used to join the beta-double prime-alumina electrolyte to the alpha-alumina insulator, which was the principal area of failure. M E P

**A79-51836** Sodium/sulfur batteries for peak power generation W Fischer, H B Gels, F Gross, K Liemert, and H Meinhold (Brown, Boveri and Cie AG, Mannheim, West Germany). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 710-714 11 refs

Load levelling and peak shaving will become more and more important because of the increasing contribution of base load plants. Several new storage devices such as batteries, flywheels and hydrogen storage systems are under discussion. This paper describes some recent progress in the development of sodium/sulfur batteries, a storage device which appears attractive due to the low cost and an expected long cycle life (Author)

**A79-51837 \* #** Recent advances in Redox flow cell storage systems. L H Thaller (NASA, Lewis Research Center, Cleveland, Ohio). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p 715-719 8 refs

Attention is given to recent data pertaining to flow cell storage system-related features as well as the state of Redox membrane technology. In addition, the state of the technology as it relates to the two application areas of storage for photovoltaic/wind and distributed energy storage for electrical utility applications is addressed. Also covered are the cost and life advantages of Redox systems as well as a discussion of such cells as the open circuit voltage cell, the rebalance cell, and the trim cell. Finally, it is concluded that the main thrust of membrane development will be to reduce the interaction between the chloro complex of iron in the ferric state since this is the major factor in membrane area resistivity. M E P

**A79-51838** **Battery engineering problems in designing an electrical load leveling plant for lithium/iron-sulfide cells.** S M Zivi, I Pollack, H Kacinskas, A A Chilenskis, D L Barney (Argonne National Laboratory, Argonne, Ill.), S Sudar, I Goldstein, and W Grieve (Rockwell International Corp., Groton, Conn.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 722-724

**A79-51839** **Process design of the LASL bismuth sulfate thermochemical hydrogen cycle** K E Cox, J H Pendergrass, and W M Jones (California, University, Los Alamos, N Mex.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 730-736 13 refs

A new process engineering flowsheet reflecting an improved design of the LASL bismuth sulfate thermochemical cycle is presented. The design is based on laboratory data that indicate a lowered endothermic heat load for a partial decomposition of the solid bismuth sulfate. A small electrical energy demand should result from operation of the sulfur dioxide electrolytic step at lower acid concentration, in principle. The results of the flowsheeting analysis yield a thermal efficiency of 50 percent for the cycle when coupled to a conceptual fusion energy heat source at 1500 K. A parametric analysis shows a slight drop in efficiency as the temperature of the heat source is decreased. The LASL bismuth sulfate thermochemical cycle appears to have potential as a means of producing hydrogen from high-temperature heat sources such as fusion, fission, and solar energy; it also appears to be competitive with alternative thermochemical cycles as well as with water electrolysis for hydrogen production (Author)

**A79-51840** **Development of a sulfur-iodine thermochemical water-splitting cycle for hydrogen production** G Besenbruch, G Caprioglio, K McCorkle, K Mysels, J Norman, D O'Keefe, J Rode, R Sharp, P Trester (General Atomic Co., San Diego, Calif.), and M Yoshimoto (Idemitsu Kosan Co., Ltd., Tokyo, Japan) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 737-742. Research sponsored by the Gas Research Institute and General Atomic Co., Contract No. EY-76-C-03-0167-PA 63

Progress in the development of the General Atomic (GA) sulfur-iodine thermochemical water splitting cycle over the last 18 months is reported. The major accomplishments have been (1) significant improvements in the chemistry of the process, (2) development, review, and revision of an engineering flowsheet, (3) screening, identification, and testing of potential materials-of-construction for the corrosive process fluids, (4) increase of the process efficiency to about 47% with additional increases projected to reach about 50%, (5) small-scale demonstration of the cycle in a closed loop under recycle conditions, and (6) installation of the next phase of scale-up equipment (bench-scale) and demonstration of parts of the process in this equipment (Author)

**A79-51841** **Hydride engines.** A A Heckes, T E Hinklebein, and C J M Northrup (Sandia Laboratories, Albuquerque, N Mex.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 743-746. Research supported by the U S Department of Energy

Hydride engines are cyclically operated by first releasing hydrogen from metal hydrides at elevated temperatures. They perform work by moving an impermeable membrane. The hydrogen is subsequently reabsorbed at a lower temperature to return the system to the original state. Five engines which operate on this principle are described, two of which have been made operational

*Efficiencies are discussed and comparisons made between Carnot, Rankine and Hydride engines which show that this engine is strongly competitive* (Author)

**A79-51842** **High efficiency alkaline electrolysis technology** J N Murray and M R Yaffe (Teledyne Energy Systems, Timonium, Md.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 747-751 9 refs. Research sponsored by the U S Department of Energy

The major approaches to increasing the operating efficiency of hydrogen production by dc electrolysis of aqueous alkaline solutions are studied. Consideration is given to the materials critical for up to 150 C deg operation and the initial data from the electrocatalyst screening experiments with the 300 sq cm electrode test modules in the applied research industrial electrolysis system (ARIES). Alkaline solution water electrolysis had demonstrated 97% voltage efficiency capability. A compromise must be considered between the premium cost of a more stable, high filtering efficiency, sintered metal powder type filter element as opposed to a lesser efficient but more stable form, such as a woven screen element V T

**A79-51843** **Laboratory model and electrolyzer development for the sulfur cycle hydrogen production process** G H Parker and P W T Lu (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, Pa.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 752-755. Contract No. EG-77-C-02-4378

The paper reviews recent progress with a closed cycle laboratory model and in electrolyzer development activities in the framework of the sulfur cycle hydrogen production process. During 1978, a closed cycle working laboratory model, sized to produce approximately 2 liters/min of hydrogen, was designed, constructed and operated at process design temperatures and one atmosphere pressure. The model uses many glass components and the high temperature items, such as the acid vaporizer and reduction reactor, are custom designed and fabricated from quartz. The development program for the depolarized electrolyzer includes evaluation of electrocatalysts, optimization of the electrode fabrication process and exploration and selection of separator materials (Author)

**A79-51844** **On design requisites for hydrogen energy systems.** M R Louthan, Jr., R P McNitt, T A Adler, and J Murali (Virginia Polytechnic Institute and State University, Blacksburg, Va.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 756-758 5 refs

Hydrogen-engineering material interaction leads to effects on mechanical properties that strongly depend on stress state, stress range, strain rates and cycling. This requires that a proposed material be evaluated in the laboratory under loading conditions that duplicate the real life exposure and utilization. Examples of hydrogen effects on a mild steel are given for a variety of test configurations and results are discussed in regards to the testing methods used (Author)

**A79-51845** **Suitability of gas distribution equipment in hydrogen service.** W J Jasionowski, D G Johnson, and J B Pangborn (Institute of Gas Technology, Chicago, Ill.) In *Intersociety Energy Conversion Engineering Conference*, 14th, Boston, Mass., August 5-10, 1979, *Proceedings Volume 1* Washington, D C, American Chemical Society, 1979, p 759-762 5 refs. Contract No. EY-76-C-02 2907

An experimental study was conducted with contemporary gas-distribution equipment in hydrogen service. Observations and results with 3 test loops initially operated on natural gas (baseline)

and then on hydrogen for 6 months indicate no incompatibilities in performance. The observed overall hydrogen-to-natural-gas leak ratio was about 3/25, and the overall energy-loss ratio was about 1/04. If piping and operating pressures are not changed, hydrogen energy delivery will be about 80% to 90% of natural gas energy delivery under turbulent flow conditions, and may be only 40% of natural gas energy delivery under laminar flow conditions. Short-term (6 months) exposure to hydrogen in distribution service did not affect the properties of metallic materials of system components; there are indications that some plastic products, some lubricants, and some adhesives were affected by the exposure (Author)

**A79-51846 Cryogenic hydrogen storage and refueling for automobiles.** W. Peschka and C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 763-767.

Based on earlier papers, new test results and experiences are reported about two tanks for liquid hydrogen, specially developed for automobile applications. Test results about evaporation rate, filling procedure and safety aspects are given. Further test results from a semi-automatic filling-station for liquid hydrogen are given. Handling and comfort of the refueling unit is comparable to that of self-service gas stations. This refueling unit, designed and constructed only for the purpose of demonstration of liquid hydrogen handling by untrained people, makes it possible to represent a basis for corresponding industrial developments (Author)

**A79-51847 Solid polymer electrolyte water electrolysis status for large scale hydrogen production.** L. J. Nuttall (General Electric Co., Wilmington, Mass.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 768-773.

The solid polymer electrolyte technology and the status of the development program are described. The goal of the program is to develop an advanced electrolysis technology for large scale commercial hydrogen generation using the solid polymer electrolyte type of cell originally developed for aerospace fuel cell and electrolysis applications. The initial phase of the program was a design study of a 58 MW system which would be suitable for a number of potential applications including energy storage, generating hydrogen for chemical and industrial feedstock or a supplement to natural gas in certain areas. The development of large scale cell hardware is proceeding in parallel with the technology development program. Performance data and projected capital costs are presented. V.T.

**A79-51848 \* Supplementary steam - A viable hydrogen power generation concept.** D. E. Wright and J. C. Lee (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 774-782. 6 refs. NASA-supported research.

Technical and economic aspects of a supplementary steam generation for peaking power applications are discussed. Preliminary designs of the hydrogen/oxygen combustors to be used for such applications are described. The integration of the hydrogen/oxygen steam-generating equipment into a typical coal-fired steam station is studied. The basic steam generation system was designed as a 20 MW supplementary system to be added to the existing 160 MW system. An analysis of the operating and design requirements of the supplementary system is conducted. Estimates were made for additional steam and fuel supply lines and for additional control required to operate the combustors and to integrate the combustor system into the facility. V.T.

**A79-51849 Thermochemical hydrogen production by the Mark-13 process - A status report.** D. van Velzen and H. Langenkamp (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 783-789. 5 refs.

A laboratory-scale complete continuous circuit has been built and operated for the demonstration of the overall chemical process where closed cycles of chemical reactions are used to decompose water into its constituting elements, hydrogen and oxygen. The hydrogen production rate of the plant is about 100 l/h. All plant items and separation units are working within their specifications. Adequate solutions to minor difficulties encountered in the preliminary phases of operation have been found and successfully applied. The plant is now running to complete satisfaction. (Author)

**A79-51850 Survey of liquid hydrogen container technology for highway vehicle fuel system applications.** W. J. D. Escher (Escher Foster Technology Associates, Inc., St. Johns, Mich.) and E. E. Ecklund (U.S. Department of Energy, Washington, D.C.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 790-795. 5 refs. Contract No. EC-77-X-01-2752.

A review of several development and demonstration projects involving liquid hydrogen containers for fuel-system service in highway transportation systems is presented. Preliminary cryogenic container industry projections of rough-estimate production costs of liquid hydrogen containers specifically engineered for vehicle use are studied. A semiautomatic liquid hydrogen service station developed in West Germany is described. Three different cryogenic hydrogen container systems were evaluated in vehicle testing in which the engine was converted to hydrogen operation. V.T.

**A79-51851 \* Toward the renewables - A natural gas/solar energy transition strategy.** J. A. Hanson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and W. J. Escher (Escher Foster Technology Associates, Inc., St. Johns, Mich.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 796-799. 6 refs.

The inevitability of an energy transition from today's non-renewable fossil base toward a renewable energy base is considered from the viewpoint of the need for a national transition strategy. Then, one such strategy is offered. Its technological building blocks are described in terms of both energy use and energy supply. The strategy itself is then sketched at four points in its implementation, (1) initiation, (2) early transition, (3) late transition, and (4) completion. The transition is assumed to evolve from a heavily natural gas-dependent energy economy. It then proceeds through its transition toward a balanced, hybrid energy system consisting of both centralized and dispersed energy supply technologies supplying hydrogen and electricity from solar energy. Related institutional, environmental and economic factors are examined briefly. (Author)

**A79-51852 \* Hydrogen as the solar energy translator.** J. H. Kelley (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1. Washington, D.C., American Chemical Society, 1979, p. 800-802. 5 refs. Research sponsored by the U.S. Department of Energy.

Many concepts are being investigated to convert sunlight to workable energy forms with emphasis on electricity and thermal energy. The electrical alternatives include direct conversion of photons to electricity via photovoltaic solar cells and solar/thermal

production of electricity via heat-energy cycles Solar cells, when commercialized, are expected to have efficiencies of about 12 to 14 percent The cells would be active about eight hours per day. However, solar-operated water-splitting process research, initiated through JPL, shows promise for direct production of hydrogen from sunlight with efficiencies of up to 35 to 40 percent The hydrogen, a valuable commodity in itself, can also serve as a storable energy form, easily and efficiently converted to electricity by fuel cells and other advanced-technology devices on a 24-hour basis or on demand with an overall efficiency of 25 to 30 percent Thus, hydrogen serves as the fundamental translator of energy from its solar form to electrical form more effectively, and possibly more efficiently, than direct conversion Hydrogen also can produce other chemical energy forms using solar energy (Author)

**A79-51853 Hydrogen from coal using pressurized gasification** D O Moore, T A Czuppon, and B G Mandelk (Pullman Kellogg Research and Development Center, Houston, Tex) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 803-806 11 refs

Raw materials for hydrogen production and industrial uses of hydrogen are discussed. Various coal gasification processes commercially available today and those under development are reviewed for their applicability to hydrogen manufacturing Based on a specific gasification technology (Texaco), an optimized process flowsheet is developed with accompanying economic data Future expansion in hydrogen economy and factors which will affect it are discussed (Author)

**A79-51854 Hydrogen program at Electric Power Research Institute** B R Mehta (Electric Power Research Institute, Palo Alto, Calif) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 807, 808 5 refs

The primary focus of EPRI's research and development programs for the electric utility industry is to provide improved technologies for efficient and reliable generation and utilization of energy economically as well as with minimum environmental impact Hydrogen as an energy carrier would provide potential to improve the economy, efficiency and flexibility of utility systems The fuel assessments have estimated that as petroleum and natural gas become very expensive or unavailable, coal-derived hydrogen will be the near term source of industrial hydrogen at costs similar to that of SNG from coal The electrolytic hydrogen will emerge as the other alternative to generate hydrogen, where specialty applications currently utilize merchant hydrogen Dedicated nuclear hydrogen plants, using pure electrochemical or hybrid electrochemical-thermochemical water splitting cycles, do not seem to significantly improve the cost compared to fossil fuel derived hydrogen (Author)

**A79-51855 Advances in H-Coal.** A G Comolli, R F Bernard, and E S Johanson (Hydrocarbon Research, Inc., Lawrenceville, N.J.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 815-820

Research on the H-Coal Process has led to the discovery of better catalysts, improved operating techniques, and increased process versatility. Equilibrium Catalyst test runs of thirty days' duration have successfully demonstrated syncrude mode operations planned for the H-Coal Pilot Plant In other PDU studies, operation has been relatively trouble-free and extended for longer periods of time than had heretofore been possible Different catalysts were tested and several were identified which considerably improve the quantity and quality of the end product The product yields were increased, and products contained environmentally acceptable levels of elements such as nitrogen and sulfur These improvements will be part of the H-Coal Pilot Plant now under construction (Author)

**A79-51856 Synthetic fuels from peat gasification** D V Punwani, S A Weil, J E Paganessi (Institute of Gas Technology, Chicago, Ill.), and M J Kopstein (U.S. Department of Energy, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 862-867 10 refs

This paper reviews the gasification characteristics of Minnesota peat, presents new results obtained with peats from North Carolina and Maine, and examines the economics of converting Minnesota peat to SNG, benzene, and oil On the basis of chemistry and kinetics, peat is better than coal for conversion to SNG because it is more reactive, requires milder operating conditions, and has a higher tendency to produce methane or synthetic liquid fuels Volatile carbon in Minnesota peat has 30% greater tendency to make methane than the North Carolina peat, and the reactivity of Maine char is lower than that of Minnesota and North Carolina peat It is concluded that the economics of converting peat to SNG is competitive with those of converting eastern coal to SNG A T

**A79-51857 Steam gasification of Illinois coal and coke.** S L Soo and R. T Gibbs (Illinois, University, Urbana, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 868-873 9 refs Research supported by Pullman Kellogg

In the MIGAS process, excess superheated steam supplies the heat of reaction for coal gasification Laboratory tests on Illinois coals and coke show that after removal of the excess steam from the product gas by condensation, the product gas has a high H<sub>2</sub>/CO ratio Various hydrocarbons were detected in the product gas via chromatography but H<sub>2</sub>S was not measurable This is because the excess steam converted all sulfur to H<sub>2</sub>S which was removed with the condensate Ash fusion did not seem to be a problem because coal remains at 100 deg C below steam temperature during gasification reaction Measured reaction rates show feasibility of the process for large-scale conversion (Author)

**A79-51858 Computer analysis of coal gasification combined cycle plants** M P duPlessis In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 874-879

A computer program has been developed to assist in the analysis of coal gasification combined cycle plants The program is described and then used to analyze the effects of gas turbine inlet temperature, air/fuel ratio and pressure ratio on the thermal efficiency and specific power output of a pressurized boiler combined cycle plant integrated with a slurry-charged entrained bed slagging gasifier The results indicate that thermal efficiencies of 36.1% to 37.1% can be achieved with present generation gas turbines (950 C inlet temperature) and 39.6 to 40.2% with advanced gas turbines (1315 C) at relatively high values of specific power (370 to 900 kW/lb/sec air) Further efficiency increases can be achieved by using a coupled pressurized boiler-exhaust boiler combined cycle The potential advantages of this cycle should be investigated further in comparative technical and economic evaluations with other alternative combined cycle plants (Author)

**A79-51859 The effect of gasifier steam demand on the overall efficiency of a coal gasification combined-cycle power plant.** R E Andermann and S S Kim (Westinghouse Electric Corp., Advanced Coal Conversion Dept., Madison, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p 880-885

This paper examines the dependence of coal gasification combined cycle (CGCC) power plant efficiency and product cost on gasifier steam demand The study of water through a CGCC power plant showed that the latent heat required to raise the steam injected into the gasifier is not recoverable, thus reducing the net available

coal energy, and resulting in lower plant efficiency for a high steam demand in the gasifier. The effect of gasifier steam on CGCC power plant efficiency is independent of gasifier type, and it is concluded that the effect of gasifier steam rate on the CGCC power plant efficiency is related to the economics of electric power cost. A T

**A79-51860** The pyrolysis route to gasification R T Eddinger (COGAS Development Co., Princeton, NJ) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 886-888

The advantages of pyrolysis for coal gasification and the details of the COGAS process pyrolysis step are presented. The pyrolysis section of this process converts a portion of the feed coal to oil and gas by the thermal decomposition of the coal in several reactors in series. The advantages of pyrolysis including its capability for making all types of coal suitable for gasification and producing a reactive char of a size similar to the feed coal are discussed, design of the pyrolysis section to heat coal in absence of oxygen and drive off volatiles as oil and gas, while avoiding agglomeration, is described. The COGAS pilot plant designed to process 50 tons/day of coal-derived char is detailed, together with the COGAS demonstration plant to produce synthetic pipeline gas, fuel oil, and naphtha from Illinois coal. It is concluded that the COGAS process combining pyrolysis with gasification is economically attractive for the production of fuel oil and naphtha. A T

**A79-51861** IGT U-GAS pilot plant developments M K Vora, J G Patel, W A Sandstrom, and A G Rehmat (Institute of Gas Technology, Chicago, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 889-894. Research sponsored by the U S Department of Energy

At the Institute of Gas Technology (IGT) significant effort has been expended to develop processes to utilize coal on an environmentally acceptable basis, including coal conversion to low- and medium Btu gas. These grades of gas can be utilized in process steam boilers, industrial heat furnaces, as a local substitute for natural gas and/or fuel oil, electricity generation in combined-cycle power plants and as a feedstock for petrochemicals. The U GAS process combines a single-stage fluidized bed gasifier with an ash agglomerating mechanism to achieve selective removal of high-ash-bearing material (agglomerates) and high carbon conversions. Successful gasification tests have been conducted that achieved carbon gasification efficiencies exceeding 90% with coal and char feeds and ash agglomerates have been produced during test operations conducted with coke breeze and bituminous coal. U-GAS process tests are being completed to produce design data at 60 psia (413 kPa) for an Industrial Fuel Gas Demonstration Plant. (Author)

**A79-51862** Equipment and strategy for environmental sampling of complex coal gasification process streams M J Pochan, J P Fillo (Carnegie Mellon University, Pittsburgh, Pa.), and M J Massey (Environmental Research Technology, Inc., Pittsburgh, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 895-898. 7 refs

The environmental characterization of coal gasification technology must be performed on sub-commercial scale facilities. Proper characterization at this scale of operation is difficult since many of the unit operations downstream of the gasifier are non-scalable and process conditions may vary significantly from those anticipated for commercial-scale operation. To avoid these difficulties, characterization efforts in the DOE program have focused on the raw gasifier product gas. Characteristics of this process stream can be linked directly to gasifier process conditions. However, characterization of the raw product gas is difficult due to severe process conditions and the rapid repetitive sampling required to adequately link these

characteristics to gasifier process conditions. These sampling difficulties were overcome, special gas sampling equipment was developed and sampling implemented successfully on the raw gasifier product gas streams of both the CO<sub>2</sub>-Acceptor and Hygas coal gasification pilot plants. (Author)

**A79-51863** New approaches and baffled heat transfer studies in fluidized bed heat storage M Y Abubakar, J L Sullivan, J D Tarasuk, and M A Bergougnou (Western Ontario, University, London, Canada) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p. 899-904. 14 refs

Fluidized heat storage is a very versatile means of storing energy either as sensible heat or by means of a change of phase material. New schemes are described involving the latter. A fluidized bed solidification unit is proposed where a molten salt is injected into a fluidized bed of solid salt, cooled by heat exchange surfaces. The molten salt solidifies on the cold solid salt particles, the heat exchanger staying, thus, free of salt deposits. The concept can also be applied to the freezing of water by a heat pump operating in a fluidized bed of ice particles. Groundwater could be frozen during winter for space heating purposes, and the ice stored for cooling during the summer. Because fluidized bed heat storage involves heat exchange surfaces, heat transfer inside a baffled fluidized bed was studied by means of a new heat flux measuring device. Data are reported for a heat exchange tube placed near a baffle inside a fluidized bed. (Author)

**A79-51864** Multistage fluidised coal combustor M R Judd and C M Eleftheriades (Natal, University, Durban, Republic of South Africa) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 905-907. Research supported by the South African Council of Scientific and Industrial Research, National Institute for Metallurgy, and South African Coal, Oil and Gas Corp

The design concept and some preliminary studies of a pilot scale multistage fluidised bed coal combustor are reported. The three stages are contained in a single pressure vessel. Combustion of the coal occurs in a medium of sand which circulates internally between stages via downcomers and externally through a pneumatic lift line and cyclones. Solids circulation is controlled by the overall pressure balances and a non-mechanical solids flow valve. Heat is recovered via immersed firetubes. (Author)

**A79-51865** An overview of in situ oil shale technology and recent advances in true in situ retort modeling. C E Tyner (Sandia Laboratories, Albuquerque, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D C., American Chemical Society, 1979, p 956-961. 13 refs. Research supported by the U S Department of Energy

In view of current liquid fuel shortages, development of the oil shale resources of Colorado, Utah, and Wyoming, estimated to contain more than one trillion barrels of oil equivalent, must be considered. The in situ processing of this resource offers a potentially attractive alternative, both economically and environmentally, to surface processing. True and modified in situ retorting technologies are described and current research in these areas briefly outlined. True in situ and related low-void in situ processes would minimize the mining and materials handling problems associated with other technologies. A comprehensive mathematical model has been developed to describe the retorting process in these beds. Use of the model to investigate the effect of various retort geometries and bed conditions on the oil yield from true in situ and low-void in situ retorts is discussed. (Author)

**A79-51866** Field performance of underground coal gasification. D R Stephens (California, University, Livermore, Calif.), C F Brandenburg (U S Department of Energy, Laramie Energy

Technology Center, Laramie, Wyo.), and E. L. Burwell (U.S. Department of Energy, Div. of Fossil Fuel Extraction, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 996-1002. 34 refs. Contract No. W-7405-eng-48.

This paper reviews the state of art in underground coal gasification (UCG), with emphasis on the U.S. DOE program. UCG offers potential advantages as a source of pipeline quality gas cost competitive with other synfuels, the use of 1.2 trillion tons of coal that would not be economical to strip or deep mine, and possible environmental advantages. The environmental issues, pipeline gas and electricity cost comparisons with alternate sources, and recent UCG results in the DOE program are discussed. Experimental gasification with air producing low BTU gas and steam/oxygen gasification producing medium BTU gas are described, and it is concluded that (1) UCG can recover the energy in unminable coal seams to ease demand for imported oil and natural gas, (2) the coal reserve for UCG is vast and widely distributed and could supply at least 300 quads as SNG, electricity, or clean liquids, (3) conversion of medium-BTU gas to transportation fuels and SNG and low-BTU gas to electricity are priorities for UCG, and (4) tests to-date confirm economic and environmental advantages. A.T.

**A79-51867** A numerical model of underground coal gasification for air-water injection into a permeable bed. M. L. Pasha and S. M. Farouq-Ali (Pennsylvania State University, University Park, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1010-1017. 20 refs.

The present investigation is devoted to the development of an unsteady state model of underground coal gasification for a porous and permeable bed. The coal may produce ash and tar and a mixture of nitrogen, methane, carbon dioxide, carbon monoxide, steam and hydrogen, as a result of pyrolysis. The reaction stoichiometry is described by nine reactions involving coal, char, and seven gases. The gasification of mixture may consist of both water and gas and thus this investigation simulates a two-phase fluid flow system. The problem is formulated in terms of thirteen equations. Because of the amount of available computer memory, the solution approach used is a combination of simultaneous and sequential steps. The set of equations is divided into three strongly coupled sets of equations and each set of equations is solved separately using direct solution techniques. (Author)

**A79-51868** Effect of noncondensables on the performance of geothermal steam power plants. H. E. Khalifa, E. Michaelides, and J. Kestin (Brown University, Providence, R.I.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1029-1033. Contract No. EY-76-S-02-4051-A001.

The influence of dissolved carbon dioxide on the thermodynamic performance of geothermal steam systems is analyzed. The system is divided into its main components: the flash tank, the turbine, the condenser and the gas extraction system, and the effect of noncondensables is studied for each. The effect of the noncondensable gas on the output of the whole system is deduced from its effect on the individual components. The analysis of actual systems is preceded by an analysis of an ideal system. The optimum condenser pressure for actual systems is obtained for different gas extraction system efficiencies. (Author)

**A79-51869** Today's geothermal power economics and risks. T. W. Lawford (EG&G Idaho, Inc., Idaho Falls, Idaho) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1034-1036.

Because of the infancy of the industry and of significant physical characteristics of the geothermal resources, significant variations in geothermal power costs have been quoted by different sources. This paper develops capital and power generation costs as a parameterized composite of a number of ongoing geothermal power projects, and evaluates several of the most commonly accepted 'risks' of geothermal power in terms of cost penalties to a basic cost of power. The status of geothermal power in the U.S. is also reviewed briefly. (Author)

**A79-51870** Low temperature geothermal energy use in existing institutional power plants. D. Kauffman and A. V. Houghton (New Mexico, University, Albuquerque, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1037-1040. Research supported by the New Mexico Energy and Minerals Department.

Preliminary system designs and economic analyses are presented for retrofit geothermal space heating for two educational institutions. For the large, relatively low temperature, deep reservoir in the Albuquerque, New Mexico, area, there is substantial economic incentive only for larger systems, typically those capable of providing 20 million Btu/hr (6000 kWt) or more. (Author)

**A79-51871** System aspects of geothermal resources utilization - The case of Castelnuovo Val di Cecina as an example. P. De Marchi Desenzani (Pavia, Università, Pavia, Italy) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1041-1044.

An attempt is made to face the perspectives for the investments in geothermal energy utilization systems in Italy, by the means of a mathematical computerized aid to decision making. An overall applied social-economic analysis and a complementary research program, suitable to the improvement of the necessary information, are supposed to be the basis for the computer assisted work. System analysis and system approach to decisions are developed with reference to a number of energy related activities that are coordinated upon a regional basis. (Author)

**A79-51874** Elementary design guidelines for Stirling engines. G. Walker (Calgary, University, Calgary, Alberta, Canada) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1066-1068.

This article presents the elementary design guidelines for Stirling engines for estimating engine performance in the conceptual stages of a project. Engines where the flow of working fluid is controlled by volume changes are called Stirling engines, and they have potential applications in the automotive, power generation, and solar energy fields. Power output and the Beale number concept, thermal efficiency, pressure ratio, work dependency, and cost of Stirling engines is discussed. It is concluded that design concepts presented should supplant excessively optimistic predictions presently made with the ideal Stirling cycle. A.T.

**A79-51882** DOE stationary external combustion engine program - Status report. R. E. Holtz, T. J. Marciniak, K. L. Uherka (Argonne National Laboratory, Argonne, Ill.), W. Bunker, and J. Facey (U.S. Department of Energy, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1 Washington, D.C., American Chemical Society, 1979, p. 1120-1123.

It is expected that Stirling engine based energy systems will be available in sizes ranging up to about 10 MWe in the late 1980s.



These systems are expected to be environmentally acceptable in that they will have low emissions, low noise, and be esthetically acceptable. It is predicted that these engines will provide substantial energy savings and cost savings while burning coal. Among potential applications of coal fueled plants are total energy plants, integrated community energy systems, industrial cogeneration, small municipal generating facilities, and pumping stations. B J

**A79-51883** **Stirling engine combustion and heat transport system design alternatives for stationary power generation.** K L Uherka, J G Daley, R E Holtz (Argonne National Laboratory, Argonne, Ill.), and W P Teagan (Arthur D. Little, Inc., Cambridge, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p. 1124-1130. 17 refs.

The paper reviews a study in support of the DOE Fossil Fuel Utilization Division program for development of large (500 to 300 Hp) Stirling engines for stationary power generation. Emphasis is on coal-based systems with high conversion efficiency for application in the industrial, commercial and residential sectors to provide electrical and thermal capacity at the point of use. Methods for integrating various coal combustors with Stirling engines are examined. Consideration is given to such indirect systems for transporting thermal energy as heat pipes, two-phase liquid metal reflux boilers, and single-phase liquid or gaseous forced circulation loops, heat transfer characteristics are presented. B J

**A79-51884** **A solar-Stirling small power system.** R L Pons (Ford Aerospace and Communications Corp., Newport Beach, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p. 1131-1135.

The paper presents results of an in-depth analysis of a 1 MWe solar power system consisting of multiple parabolic dish concentrators employing Stirling cycle engines for power conversion. The engine, ac generator, cavity receiver and integral sodium pool boiler/heat transport system are combined in a single package and mounted at the focus of each concentrator. The output of each concentrator is collected by a conventional electrical distribution subsystem which permits either grid-connected or stand-alone operation, depending on the choice of storage system selected. For annualized capacity factors in excess of 0.40, storage is required. The system can accommodate a number of options, including lead-acid batteries, advanced batteries, or fly-wheels. Without storage, system capital cost is less than \$1000/kW, based on the production of 5000 MW per year by the 1990 time period. Associated life-cycle energy cost (levelized) is approximately 53 mills/kWh. (Author)

**A79-51888** **Advances in Stirling engine technology.** J R Senft (Sunpower, Inc., Athens, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p. 1175-1180.

The paper describes several Sunpower programs involving the design, testing, development, and commercial production of a family of free piston Stirling engine alternators, water pumps, and cooling machines. Particular attention is given to the SD-100 program, the RE-1000 program, and the 661 crank engine program. B J

**A79-51889** **Design characteristics of an advanced Stirling engine concept.** J Vos (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p. 1191-1196.

This paper deals with the design of a double acting four cylinder Stirling engine termed Advenco, which is an acronym for advanced engine concept. In this engine a number of advanced ideas are tried out. For instance the quantity of expensive heat resistant material is

substantially reduced by using a ceramic material as an insulating wall inside the cylinder and regenerator housings. Furthermore the power is controlled by varying the piston stroke, leading to a favourable part load efficiency. Finally special attention has been paid to the external sealing. The rollsock used for this purpose is enclosed in a cassette system which makes replacement easy. In this paper the design features of this advanced Stirling engine are described. (Author)

**A79-51890** **A variable angle wobble plate drive for a stroke controlled Stirling engine.** R J Meijer (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) and B Ziph (North American Philips Laboratories, Briarcliff Manor, N.Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 1, Washington, D.C., American Chemical Society, 1979, p. 1197-1202.

A drive mechanism has been developed for a variable displacement Stirling engine for automotive propulsion. It features a variable angle wobble plate mechanism and utilizes rolling element bearings. This paper describes the mechanism, its motion, dynamic characteristics, and the wobble plate angle control. The mechanism converts reciprocating motion into rotary motion in such a way that constant angular speed rotation of the main shaft will result in purely sinusoidal linear motion of the reciprocating pistons. It is amenable to perfect dynamic balancing for any number of pistons. The variation of the plate angle is accomplished by mounting it on the shaft at an acute angle and then rotating it around and relative to the shaft. The drive mechanism is an integral part of a complete power train designed as a single system for a front wheel drive 3,500 lb passenger automobile. (Author)

**A79-51891 \* #** **Results from Symposium on Future Orbital Power Systems Technology Requirements.** S Gorland (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2, Washington, D.C., American Chemical Society, 1979, p. 1203-1206.

Technology deficiencies, adequacy of current programs, and recommendations for reducing the testing and risks involved in future orbital energy systems made at the NASA Symposium are summarized. Photovoltaic space power system problems, including structural dynamics and attitude control problems due to solar array flexing; solar cell radiation resistance, manufacturing capability, and cost reduction, solar arrays including inflatable arrays, spectrum selection to increase efficiency, and polymer coatings for cells, battery technology, the endurance data base for fuel cell and electrolysis technology, and power management were discussed. Other topics considered were laser/microwave power transmission, thermal management, nuclear power systems, and environmental interactions. It was concluded that a 'front end' system study is needed in each area and current programs for multi-hundred-kW power systems are underscoped. A T

**A79-51892** **Orbital antenna farm power systems challenges.** F H Esch and W L Morgan (COMSAT Laboratories, Clarksburg, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2, Washington, D.C., American Chemical Society, 1979, p. 1207-1212. Research sponsored by the Communications Satellite Corp.

This paper describes possible orbital antenna farm (OAF) systems and identifies power system design problems which must be solved. The OAF is a space platform which combines a variety of communication services on a common platform and provides varying amounts of electric power depending on amounts of communications service. Long life and high reliability are economic justifications for OAF, so that an OAF platform is expected to operate for several decades. The platform capabilities of the several initial space stations of the OAF class and applications missions of the earliest OAF designs in the geostationary orbit are summarized. The platform

power distribution among these missions, space station construction, and interconnected platforms for global traffic are discussed. The OAF electric power system, including nuclear and photovoltaic generators, and energy storage systems, such as thermoelectric conversion and rotating/moving devices are described. A.T.

**A79-51893 # The military space power program.** R. R. Barthelemy (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1213-1215. 6 refs.

This paper examines a trend toward military space power requirements in the 10 to 100 kWe range due to probable needs for advanced surveillance and communications missions. Solar cell development, spacepower thrust roadmap weapon hardening, roadmap thermal and high power, and electrical energy storage are discussed, noting that significant performance enhancements in solar cell efficiency and battery energy density have been achieved of major importance in spacecraft designs. The programs include flexible rolled-up solar array, hardened array solar power system, the 2kWe long life battery, the multiple phase high efficiency solar panel, the Nickel-Hydrogen Battery, and nuclear dynamic power system applications/integration study. A.T.

**A79-51894 \* # The NASA Space Power Technology Program.** J. P. Mullin, W. R. Hudson, and L. P. Randolph (NASA, Space Power and Propulsion Office, Washington, D.C.) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1216-1224. 22 refs.

This paper discusses the National Aeronautics and Space Administration's (NASA) Space Power Technology Program which is aimed at providing the needed technology for NASA's future missions. The technology program is subdivided into five areas: (1) photovoltaic energy conversion, (2) chemical energy conversion and storage, (3) thermal to electric conversion, (4) power system management and distribution, and (5) advanced energetics. Recent accomplishments, current status, and future directions are presented for each area. (Author)

**A79-51897 \* A power extension package /PEP/ for the Shuttle Orbiter.** H. C. Ness (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1237-1240. 8 refs. Contract No. NAS9-15532.

A concept for solar array augmentation of the power normally provided by the Shuttle Orbiter fuel cells in support of payloads is discussed. Justification for the use of solar arrays rather than additional cryogenic fuel kits for extension of on-orbit stay time is presented. This is followed by a description of the array power system and an examination of its interfaces with the existing Orbiter fuel cell system. The system produces 29 kW total with 14 kW allocated to the Orbiter and 15 kW to payloads and permits an increase in on-orbit mission duration from 6 to approximately 20 days at 21 kW with four cryo kits. It is capable of producing full output in diverse vehicle orientations since the array is deployed and oriented by the Orbiter remote manipulator system (RMS). Power produced by the arrays is reduced to 32.25 to 32.5 volts by pulse-width-modulated buck voltage regulators to force the Orbiter fuel cells into an idle mode during the sunlit portions of the orbit. (Author)

**A79-51898 # A DOD space energy module.** R. R. Barthelemy and V. A. Shelley (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1241-1243. 7 refs.

The development of a high level, high power density space energy module capable of being delivered to synchronous orbits and survivable in radiation environments for the future high power DOD missions in space is presented. The mission requirements for 10 to 50 kW energy systems capable of controlling and rejecting thermal energy at these power levels, launch system design based on the Space Shuttle constraints and capabilities, and the energy module concept based on delivering 25 kW at the end of 7 years and rejecting the same amount of energy in a 5000 lb weight system are discussed. Finally, the electrical power and thermal systems are described, and it is concluded that the DOD space energy module will provide a high performance energy package capable of satisfying all the energy needs of the overall space system. A.T.

**A79-51899 Long-term prediction of power system performance for geosynchronous spacecraft.** W. J. Billerbeck (COMSAT Laboratories, Clarksburg, Md.) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1244-1249. Research sponsored by the Communications Satellite Corp. and International Telecommunications Satellite Organization.

New techniques for the prediction of future electric power capabilities of operational geosynchronous communications satellites are presented. These techniques were developed for the computer modeling of Ni-Cd battery performance, incorporating parameters of current, temperature, number of discharge cycles, and the effect of reconditioning on voltage performance. The model was correlated with long-term in-orbit data on a number of spacecraft batteries, and then applied by fitting to individual batteries to predict their performance. Long-term performance prediction for solar cell arrays was performed on spacecraft using a computer model based on the measured prelaunch characteristics extrapolated to space, and the model was then used to predict future electrical performance. A.T.

**A79-51901 Potential of GaAlAs solar cells for the global positioning system missions.** W. C. Schmill (Rockwell International Corp., Satellite Systems Div., Downey, Calif.) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1257-1263. 20 refs. Contract No. F04701-74-C-0527.

Gallium aluminum arsenide (GaAlAs) solar cells are evaluated for a navigational satellite mission. Both planar and concentrated solar arrays (400 to 1000 W) were analyzed. The predicted performance of early production (1982-83) GaAlAs solar cells would have an efficiency of 16.4 percent (25 C), and for the mission particulate radiation fluence degrade in power 2/3 that of silicon devices and cost 2.4 times silicon solar cells. Results of the analysis indicate that early production GaAlAs solar cells can be competitive with current production silicon solar cells on a dollar-per-watt basis and produce 20 percent more power for the same size array. With improvements in either GaAlAs solar cell efficiency, radiation hardness, and anticipated cost reductions resulting from mature production, it is indicated that GaAlAs solar cells would result in solar array cost, weight, and area savings compared to silicon cells. (Author)

**A79-51902 \* High temperature, low mass solar blanket development.** H. G. Mesch (TRW Defense and Space Systems Group, Redondo Beach, Calif.) and D. E. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In: Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1264-1269. Contract No. NAS7-100.

This paper presents methods of incorporating ultrathin silicon solar cells into photovoltaic blankets for space applications. This type of cell has the highest power-to-mass ratio and best performance.

under space radiation of any silicon solar cell. Interconnect materials and designs, and the results of the investigation of the applicability of parallel-gap resistance welding for interconnecting ultrathin cells are discussed. Data relating contact pull strength and cell electrical degradation to welding parameters such as time, voltage, and pressure are presented. Methods for bonding ultrathin cells to flexible substrates and for bonding thin covers to these cells are described, and the results of vacuum thermal cycling and thermal soak tests on prototype ultrathin cell test coupons are included. A T

**A79-51903 \*** High efficiency ultrathin silicon solar cells. G Storti and C Y Wrigley (Solarex Corp., Rockville, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1270-1272. Contract No. JPL-954833

This paper summarizes developments in ultrathin, (50 micron), silicon solar cells for high power to-weight ratio space power systems. The fabrication technology developments included uniformly thinning oriented silicon slices, enhancement of internal reflection, optimizing high-temperature processes, surface texturing and back surface field enhancement. The best textured surface ultrathin cells have achieved 14.3% AMO efficiency, while pilot-manufacturing quantities of smooth-surfaced cells have been fabricated with efficiencies of 12%. Data are presented on cell structure, fabrication collection efficiencies and optical properties. (Author)

**A79-51905** Enhancement of solar arrays in space through the use of concentrators. I Baker (Hughes Aircraft Co., El Segundo, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1278-1282. 5 refs

Results are presented of a conceptual design study and comparative evaluation of solar concentrators for enhancing the performance of photovoltaic arrays in space. Six design concepts, utilizing thin film Kapton mirrors to concentrate sunlight onto a 25 kW baseline array, are compared relative to performance and cost related parameters. Effectiveness from 1 to 6 AU, considering silicon and gallium arsenide solar cells, and vapor deposited aluminum (VDA) and 'cold mirror' reflector coatings, are evaluated. At 1 AU with silicon solar cells results show moderate improvement in specific power through the use of concentrators. When operating at greater than 1 AU, concentrator effectiveness is dramatic. Improvements as great as 300 percent in specific power or 1,570 percent in total power output using silicon solar cells were shown at 6 AU. If gallium arsenide cells are employed at 1 AU, concentrator effectiveness is increased. Better results were achieved with the VDA reflector coating than with the particular 'cold mirror' coating investigated. (Author)

**A79-51923 #** Thermal management for future Air Force high power spacecraft. E T Mahefkey (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1374-1376. 6 refs

High power military missions, surveillance, space defense, and secure command, control, and communications are described, as are the military design requirements based on survivability. Potential thermal control component technology developments are suggested as a means to improve both reliability and autonomy. These include large, deployable, retractable spacecraft radiators, long-life (10 year) multilfluid pump development, and extension of present heat-pipe technology to accommodate the more sophisticated temperature regulation (+ or - 0.5 C), higher transport capacity, and more unusual geometrical constraints envisioned. V T.

**A79-51924 \* #** Heat rejection development requirements for orbital power systems. J G Rankin and W E Ellis (NASA, Johnson Space Center, Houston, Tex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1377-1381. 6 refs

Long-term orbital applications in which large amounts of electrical power are generated and utilized will require waste heat rejection beyond the capabilities of existing radiator systems. Therefore, it will be necessary to develop a new concept for large orbital energy systems. This paper presents a discussion of the primary factors to be considered in the design and development of a large orbital power module heat rejection system. Specific design requirements are defined based on these factors, and a review of supporting technology in the advanced space radiator area is presented. A proposed development approach and a candidate baseline heat rejection system are then identified and discussed. (Author)

**A79-51927** Status report of the dynamic isotope power system. G L Sorensen, R E Niggemann, E C Krueger (Sundstrand Advanced Technology Group, Rockford, Ill.), R C Brouns (U.S. Department of Energy, Washington, D.C.), and F A Russo (Teledyne Energy Systems, Timonium, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1396-1400

The development status of a dynamic space power system for use in satellites of the 1980s is discussed in this paper. This dynamic system is plutonium oxide fueled, organic Rankine cycle turbine power system producing electric power. This program was initiated with Sundstrand by the Department of Energy in August 1975, the Phase I effort was completed in June 1978. In Phase I, a flight system concept design was made and a ground demonstration system was designed, fabricated, and tested to prove the feasibility of the flight design. The current Technology Verification Phase is to improve system efficiency by component development and to further demonstrate system reliability by endurance testing a minimum of 5,000 hours. The system configuration and test results of the program to date are discussed. (Author)

**A79-51928** Dynamic Isotope Power Systems (DIPS). J E. Boretz, E Nezgoda (TRW Defense and Space Systems Group, Redondo Beach, Calif.), R R Barthelemy, and T Mahefkey (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1401-1405. 7 refs

The major technology and survivability issues concerning the use of Dynamic Isotope Power Systems (DIPS) for future space application are discussed. Power levels considered for the DIPS are 1 to 10 kWe. An operating life of 7 years with a mean mission duration (MMD) of 5 years is achievable and consistent with the KIPS program. Typical operating conditions for KIPS are described along with a flight system block diagram. KIPS flight development characteristics are outlined. It is noted that there are many inherent features of DIPS/KIPS systems that potentially could enhance satellite survivability. V T.

**A79-51929** Application of the Dynamic Isotope Power System to a multimission spacecraft. W D Kenney (U.S. Department of Energy, Washington, D.C.), W Z Prickett (General Electric Co., Space Div., Philadelphia, Pa.), and E C Krueger (Sundstrand Advanced Technology Group, Rockford, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1406-1410. Research sponsored by the U.S. Department of Energy.

Integration of the Dynamic Isotope Power System (DIPS) into a multimission spacecraft is discussed, and the resulting nuclear

integrated multimission spacecraft (NIMS) is presented for candidate DOD missions. The DIPS Rankine-cycle pumped coolant is used for electronics and other subsystem cooling for both normal operations and during threat encounter. The payload and NIMS housekeeping electronics are mounted on an annular panel located inside the NIMS radiator envelope. A single NIMS bus may be developed which is compatible with the six mission payload assessed. Consideration is given to mission selection and requirements. V T

**A79-51930** Selection of power plant elements for future reactor space electric power systems. D Buden (California, University, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1411-1417. Research sponsored by the U S Department of Energy.

The mission requirements for high power, small size and long lifetimes imply the need for a fast spectrum, highly enriched reactor that will have a large inventory of fuel in a small volume. Consideration is given to heat pipe-cooled and gas-cooled reactors, including Brayton-cycle gas-cooled and liquid-cooled reactors. Emphasis is placed on converter system design. It is determined that a heat-pipe reactor provides a means for emergency-cool-down in the design without large emergency cool-down fluid storage systems. This can be done by the addition of fins on the end of the reactor heat pipes with power to the fin section regulated by a gas reservoir. V T

**A79-51931 \*** Reactor design for nuclear electric propulsion. D R Koenig and W A Ranken (California, University, Los Alamos Scientific Laboratory, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1418-1424. 5 refs. Research sponsored by the U S Department of Energy and NASA.

The paper analyzes the consequences of heat pipe failures, that resulted in modifications to the basic design of a heat-pipe cooled, fast spectrum nuclear reactor and led to consideration of an entirely different core design. The new design features an integral laminated core configuration consisting of alternating layers of UO<sub>2</sub> and molybdenum sheets that span the diameter of the core. Design characteristics are presented and compared for two reactors. A conceptual design for a heat exchanger between the core and the thermionic converter assembly is described. This heat exchanger would provide design and fabrication decoupling of these two assemblies. V T

**A79-51932** Baseline design of the thermoelectric reactor space power system. W A Ranken and D R Koenig (California, University, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1425-1431. Research sponsored by the U S Department of Energy.

An alternative for a nuclear reactor space power system capable of delivering 10-100 kWe is presented, that employs the use of a heat-pipe-cooled fast spectrum reactor with a thermoelectric power conversion system. The reactor design features a laminated core configuration with sheets of molybdenum extending across the full diameter of the core - interspersed between layers of UO<sub>2</sub>. The general configuration of the baseline power system is given showing the reactor core encased in a beryllium reflector. Attention is given to the conversion system which is accomplished by a network of thermoelectric elements based on silicon/germanium alloys, built into cylindrical modules surrounding the core heat pipes. Early key results showed that fuel temperatures are not excessive even when employing radiation, and that analysis has shown the layered fuel form to be less sensitive to incomplete thermal contact between the core components than expected. C F W

**A79-51933** Use of modular heat source stack in RTGs. A Schock and A Shostak (Fairchild Space and Electronics Co., Germantown, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1432-1439. Contract No. EN-77-C-02-4281.

A proposed light-weight scheme for solving problems encountered in the use of stacked heat source modules in a radioisotope thermoelectric generator (RTG) is described and illustrated with an actual RTG design for the NASA/ESA International Solar-Polar Mission. A detailed analytical model of the RTG and the spacecraft to which it is attached was constructed, and a NASTRAN analysis was carried out to assess the structural performance of the heat source scheme under differential thermal expansion. It was also used to determine dynamic launch loads, the systems characteristic frequencies, the loads transmitted to the RTG, and the resultant stresses and displacements. Attention is given to the structural analysis of a model RTG and the resonances and resultant deformations that occur. It was determined that the analysis demonstrated the structural viability of the basic scheme for supporting a long heat source stack without intermediate supports, under the anticipated static, dynamic, and thermal expansion loads. C F W

**A79-51935** Design optimization of RTG for Solar-Polar Mission. A Schock and H Sookiazian (Fairchild Space and Electronics Co., Germantown, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1444-1454. 5 refs. Contract No. EN-77-C-02-4281.

The paper presents the conceptual design of an RTG, employing stacked radioisotope heat source modules and silicon germanium thermoelectric couples, for use on the joint NASA/ESA International Solar-Polar Mission. It describes a computer program which, for a given set of assumptions and ground rules, can rapidly examine thousands of design variations and determine the combination of design parameters which will minimize the RTG weight for a given power output. Graphical results are presented to illustrate design trends and clarify the optimization procedure. The generated results lead to interesting and somewhat unexpected conclusions about optimum design parameters, the relative constancy of RTG specific power over a wide power range, comparisons between single and split RTGs, sensitivity to variations in heat source module design, weight comparisons with the MHW RTG, and comparative RTG weights for different housing and radiator fin materials. (Author)

**A79-51936 \*** Radioisotope thermoelectric generator cooling in the Shuttle bay. L D Stimpson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and D I Levine (Rockwell International Corp., Downey, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings, Volume 2. Washington, D C., American Chemical Society, 1979, p 1455-1460. Contracts No. NAS7-100, No. NAS9 14000.

The paper describes a Shuttle-integrated radioisotope thermoelectric generator (RTG) that consists primarily of a pump package and plumbing connected directly to the Shuttle payload heat exchanger. The RTG utilizes on-board water evaporative cooling capability, which is normally used for ascent, entry, and for supplementing the radiators. Attention is given to the RTG cooling concepts which include (1) an active thermal cooling system (ATCS), where two Freon-21 loops operate simultaneously to transport heat from the Orbiter subsystem and payloads through liquid-to-liquid heat exchangers and pin-fin coldplates to four heat sinks, and (2) an atmosphere revitalization system (ARS) which provides for thermal, pressure, and contaminate control of the crew cabin and its equipment. The use of a payload heat exchanger to reduce weight, cost and complexity associated with an independent cooling system was investigated in detail. C F W

**A79-51937** Performance limits for liquid-metal heat pipes containing long adiabatic sections. F C Prenger, Jr and J E Kemme (California, University, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1461-1465 6 refs Research supported by the U.S. Department of Energy

Analytical and experimental investigations of the performance limits of liquid-metal heat pipes containing long adiabatic sections were made. An analytical model describing the vapor flow and including the effects of wall friction and compressibility is presented. Performance limits and axial temperature profiles of a sodium-filled, stainless steel heat pipe were measured for comparison with the analytical results. Complete validation of the analytical model requires further experiments. The results show that a transition from laminar to turbulent vapor flow occurs in the adiabatic section with an accompanying decrease in the heat-pipe performance limit. The reduced performance results from an increased wall friction factor for the turbulent flow (Author)

**A79-51938** Copper/water axially-grooved heat pipes. Fabrication and performance testing. N P Strazza (Teledyne Energy Systems, Timonium, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1466-1469 Contract No. ET-76-C-01-2865

Well-controlled fabrication techniques have proven to be essential for obtaining optimum performance and long term operation of copper/water axially-grooved heat pipes. Life test results demonstrating long term operation, up to 11,500 hours, is achieved with a copper/water system operating at temperatures up to 225 C. This paper discusses the experience obtained in the fabrication and reliability testing of copper/water axially-grooved heat pipes. Fabrication experience, life-test results, and destructive and nondestructive analyses of life-tested and of as-fabricated heat pipes are presented. Performance data shows no significant degradation of heat transport or thermal conductance capability of the heat pipes. Chemical analyses of the water charge, residual gas analyses, internal heat pipe surface chemistry and metallographic findings are also presented. Additionally, this paper discusses the chemistry of known potential contaminants resulting from improper fabrication techniques and recommendations for successful fabrication (Author)

**A79-51940** SNAP 19 performance update for Pioneer and Viking missions. C J Goebel and L R Putnam (Teledyne Energy Systems, Timonium, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1476-1479

The paper examines SNAP-19 radioisotope fueled thermoelectric generators that are employed in four missions including Pioneer 10 and 11 and two Viking Landers. A performance model is presented that considers RTG material properties and the effects of environmental deviations. Results are compared with telemetry data from the Pioneer flights and it is shown that the NASA required minimum power levels, which were set at a 50% probability to exceed 105.3 watts, will be met. C F W

**A79-51941 \*** Computer modeling for a space power transmission system. S M Rathjen (Boeing Aerospace Co., Seattle, Wash.) and D K Reynolds (Washington, University, Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1480-1485 12 refs Contracts No. NAS9-15636, No. NAS9-15196

The paper summarizes the development of a computer program that simulates the performance of a large phased array antenna composed of 7220 smaller subarrays, each made up of klystron modules which act as individual radiators. The purpose of this program is to (1) study the far-field pattern near the rectenna, (2) calculate the beam efficiency, and (3) observe the grating lobe behavior. Attention is given to the computer program which consists of a main program and four subroutines, as well as to the system configurations. The effects of amplitude, phase and random subarray failures are examined and an error budget was specified for 10 to the 0 phase error, + or - 1 dB amplitude error, and a 2% random failure rate. C F W

**A79-51942** A European view of the solar satellite power system. K Bogus, D Kassing, and K K Reinhartz (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1486-1491 13 refs

The paper discusses the European energy situation and the potential role of solar-powered systems (SPS) with emphasis on specific European tasks and aspects. Attention is given to the energy supply and demand needs as well as to the present status of European SPS activities. Possible future activities are examined and a 10 point SPS program is presented. The use of photovoltaic conversion systems such as silicon solar cells are investigated and calculations for power vs consumption are made. C F W

**A79-51943** The technology base for the microwave power transmission system in the SPS. W C Brown (Raytheon Co., Waltham, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1492-1499 13 refs

The microwave power transmission system in the Solar Power Satellite (SPS) is reviewed in terms of the existing technology base. This technology base consists of (1) the experience that has been obtained from complete transmission systems including the interconversion of dc and microwave energy at both ends of the system and all of the interfaces between various parts of the system, (2) the efficient conversion of dc power into microwave power, (3) the microwave beam link itself, and (4) the efficient collection of microwave power at the receiving end of the link and its conversion back into dc power. Special emphasis is placed upon recent additions to this technology base and also upon the critical nature of some of the microwave technology that is needed to meet the SPS requirements (Author)

**A79-51944 \*** Microwave system performance for a solar power satellite during startup/shutdown operations. G D Arndt and L A Berlin (NASA, Johnson Space Center, Houston, Tex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1500-1505 6 refs

The paper investigates the system performance and antenna characteristics under startup/shutdown conditions for the high power beam from a solar power satellite. Attention is given to the present microwave system reference configuration together with the dc power distribution system in the solar array and in the antenna. The pattern characteristics for the main beam, sidelobes, and grating lobes are examined for eight types of energizing configurations which include random sequences, two types of concentric circles, and three types of line strips. In conclusion, it is noted that a proper choice of sequences should not cause environmental problems due to increased microwave radiation levels during the short time periods of energizing and de-energizing the antenna. C F W

**A79-51945 \*** **Applicability of solid state microwave technology to solar power satellites.** E J. Nalos, G W Fitzsimmons, and B R Sperber (Boeing Aerospace Co., Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1506-1511 18 refs Contract No NAS9-15636

A potential SPS design using antenna mounted GaAs FET's as the basic dc RF converter is described, together with the rationale of why such a design may represent a viable cost effective complement to current SPS designs using tube type dc RF converters such as klystrons or crossed field amplifiers. An initial description of a microwave antenna array module is given, together with a concept of how such a module is to be integrated into the SPS overall design. A comparison is made of several such designs using either antenna mounted or solar cell mounted dc-RF converters (Author)

**A79-51946** **Synfuel /hydrogen/ production from fusion power.** R A Krakowski, K E Cox, J H Pendergrass, and L A Booth (California, University, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p. 1544-1548 23 refs

A potential use of fusion energy for the production of synthetic fuel (hydrogen)- is described. The hybrid-thermochemical bismuth-sulfate cycle is used as a vehicle to assess the technological and economic merits of this potential nonelectric application of fusion power (Author)

**A79-51947** **Advanced synfuel production with fusion.** J R Powell and J. Fillo (Brookhaven National Laboratory, Upton, N Y.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1549-1552 Research supported by the U S Department of Energy

Principles of high-temperature water electrolysis and results of design study are discussed. High-temperature electrolysis (HTE) has the highest potential efficiency for production of synfuels from fusion. Relative to thermochemical or direct decomposition methods, HTE technology is in a more advanced state of development, e.g., single cell units have been built and tested at 1000 C. It is noted that HTE units offer the potential to be quickly run in reverse as fuel cells to produce electricity for restart of tokamaks and possible spinning reserve for a grid system. V T

**A79-51948** **Nitrogen fixation with fusion heat.** L. H. Rovner, K. J. Mysels, D. D. Peterman, and D W Kearney (General Atomic Co., San Diego, Calif.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1553-1558 19 refs Research supported by the Northeast Utilities Service Co and Public Service Electric and Gas Research Corp

The paper presents a preliminary analysis of the Wisconsin pebble-bed process. Process description is given along with process calculations carried out to examine the characteristics and optimal design parameters for the process. The design selections are flexible and give relatively broad maxima in process efficiency so that the process energy requirements can be designed with the characteristics of the fusion energy heat source. It is noted that the process is compatible with tritium breeding and the resultant energy-temperature heat characteristic of the reactor used in the process, is economic by comparison with competitive processes, and is conservative of nonrenewable resources V T.

**A79-51949** **CO/H2 production using fusion reactor heat.** E L Klosterman, R T Taussig, P E Cassidy, W T Thayer, L C Steinhauer, M Shirazian, and D Damon (Mathematical Sciences

Northwest, Inc., Bellevue, Wash.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1559-1564 14 refs Contract No ET-78-C-06-1095

The paper describes the preliminary results of an analytic study conducted to determine the feasibility of producing CO using fusion reactor heat and gas dynamic compressing heating. The CO produced in this process is separated out and reacted with steam in a water-gas shift to form H2. Key elements in the system include a high temperature fusion reactor blanket, a chemical wave reactor where gas dynamic heating and cooling occur, and a chemical separation plant. The question of technical feasibility is focused on three aspects of the system, namely, the high temperature fusion blanket design, the performance of the wave reactor, and the processes for converting the CO from the 'frozen gas mixture' to H2 V T

**A79-51950** **Engineering aspects of demonstration fusion power reactors.** M Biggio, G. Casini, F Farfaletti-Casali, F Lanza, R Matera, G Pierini, C Ponti, F W Reiter, M Rieger, and P Rocco (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1565-1571

Conceptual design study of a demonstration power reactor plant (FINTOR-D), of tokamak-type, is reviewed. FINTOR-D is defined as a full fusion plant generating electric power, able to demonstrate the feasibility of all the technologies required for a prototype reactor station. The study objective is to assess the principal physical and engineering limits connected with varying levels of capability of experimental fusion reactors. The following components are considered: (1) first wall, blanket, and magnet shields, (2) supporting structures of the reactor and magnetic coils, (3) vacuum containment systems, and (4) tritium cycle systems (plasma exhaust process, recovery from blanket, and coolant purification) V T

**A79-51951** **Chemical processing of liquid lithium fusion reactor blankets.** J R Weston, W. F. Calaway, R M Yonco, J. B. Hines, and V A. Maroni (Argonne National Laboratory, Argonne, Ill.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D C, American Chemical Society, 1979, p 1572-1576 15 refs. Research sponsored by the U S Department of Energy

The first series of molten-salt extraction tests on the 50-gallon-capacity lithium-processing test loop (LPTL) using LiF-LiCl-LiBr are reviewed along with an analysis of the zirconium getter wires from the 10,000 hour lithium minitest loop (LMTL) test run. Test results indicate that a combination of salt extraction and cold trapping should provide adequate recovery and impurity control. It is expected that the hydrogen isotopes, nitrogen, and to some extent carbon will be removed via the salt extraction equipment and that cold trapping will control carbon, oxygen, and halogen levels V T.

**A79-51952** **Tritium permeation through steam generator materials.** J T Bell and J D Redman (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2

Washington, D.C., American Chemical Society, 1979, p 1577-1582 17 refs Contract No W 7405-eng-26

Various subjects related to tritium permeation through steam generator materials are discussed. Isotope effects based on protium and tritium permeabilities of nickel range from 1.36 at 500 K to 1.63 at 1000 K. Tritium permeation rates from a given quantity of T2 molecules will be reduced by the addition of protium and/or deuterium to a point where the tritium rates approach an inverse 0.5-power dependence on the protium and/or deuterium pressures. The permeability constants and the permeation activation energies

essentially are equal for several ferritic alloys, but these parameters are significantly different from those for several austenitic type alloys. Oxide layers on construction alloys can reduce permeation rates by 2 to 3 orders of magnitude but information on this subject may not be applicable to operating steam generator systems. Recent results indicate that tritium permeation rates through oxide and glass materials are 0.5 rather than first-power dependent on pressure.

(Author)

**A79-51954** A high temperature fusion reactor design. S. D. Harkness, J. F. dePaz, M. Y. Gohar, and H. C. Stevens (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1590-1596. 6 refs.

A conceptual design of a blanket for a 7 m tokamak reactor is discussed, one that is capable of producing 1100 C process heat at a pressure of about 10 atmospheres. The design is based on the use of a falling bed of MgO spheres as the high-temperature heat-transfer system. The tritium breeding is accomplished using Li<sub>2</sub>O modules both in front of and behind the high temperature ducts. Steam is used as the first wall and front tritium breeding module coolant, while helium is used in the rear tritium breeding region. The system produces 600 MW of net electricity for use on the grid.

V T

**A79-51955** The lithium boiler - A 1500 to 2000 K fusion reactor blanket concept for process heat and/or electric power generation. J. H. Pendergrass, L. A. Booth, D. R. Peterson, and S. A. W. Gerstl (California, University, Los Alamos, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1597-1607. 37 refs.

A fusion reactor blanket concept has been developed which avoids restrictions characteristic of other blanket concepts on simultaneous delivery of almost all neutron energy as high-temperature thermal energy and achievement of tritium breeding ratios of one or greater. Suitable for either inertial confinement or magnetic confinement fusion applications, the concept involves deposition of 14.1-MeV fusion neutron kinetic and exoergic interaction energy, a majority of total fusion reactor energy release, in 1500 to 2000 K boiling lithium. Lithium vapor flow to, and condensation on, heat exchanger surfaces constitutes the efficient primary blanket heat transport mechanism.

(Author)

**A79-51956** Fusion-supported decentralized nuclear energy system. D. L. Jassby (Princeton University, Princeton, N.J.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1608-1613. 19 refs. Contract No. EY-76-C-02-3073.

A decentralized nuclear energy system is proposed, comprising mass-produced pressurized water reactors in the size range 10 to 300 MW (thermal), to be used for the production of process heat, space heat, and electricity. Attention is given to maximizing the refueling interval in order to reduce fuel transport, reactor downtime, and opportunity for fissile diversion. The preferred fissile fuel is U-233. Application of the neutral-beam-driven tokamak fusion-neutron source to a fissile breeding pilot plant is discussed. This scheme can be extended in part to a decentralized fusion energy system, wherein remotely located large fusion reactors supply excess tritium to a distributed system of relatively small nonbreeding deuterium-tritium reactors.

V T

**A79-51957** Thermonuclear energy from ball lightning. G. C. Dijkhuis (Zeldenzust College, Terneuzen, Netherlands) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1614-1617. 6 refs.

Ball lightning is treated as a turbulent plasma sphere with reversible transport of charge and energy. Model equations for current and heat flux lead to solutions with (1) internal circulation of charged plasma in a twin pair of counterrotating vortex rings, (2) central temperatures and densities with thermonuclear potential.

(Author)

**A79-51958** The indirect Brayton energy recovery system. B. E. Lampinen, R. R. Gutowski, A. Topouzian, and M. A. Pulick (Ford Motor Co., Dearborn, Mich.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1625-1629.

The indirect Brayton energy recovery system (IBERS) concept is described. Waste exhaust gas is expanded from atmospheric to sub-atmospheric pressure, through a turbine. The exhaust gas leaving the turbine is passed through a heat exchanger, where it is cooled. The cooled gas is then compressed back to atmospheric pressure by a compressor coupled to the turbine. The performance of the IBERS demonstration model proves that the concept is feasible. Under the unbalanced flow conditions, the unit reaches design speed and supplies surplus power. However, test data show that the two critical components in the system are the heat exchanger and compressor. Further investigations are required to determine if an IBERS can endure an industrial environment.

(Author)

**A79-51959** Electricity rate systems and energy conservation. B. Larkin (National Research Council, Div. of Mechanical Engineering, Ottawa, Canada) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1658-1661. 5 refs.

Two cases are discussed: the case of ventilation heat recovery system and the case of solar heating system. Residential heat pumps are also considered along with the economics of system expansion. It is noted that most electricity rate systems do not reproduce exactly the effect of load factor on electricity costs. As a result, electrical loads with a low load factor are indirectly subsidized by the utility and other customers. The customer then tends to choose electricity rather than alternatives. Utilities should not actively promote expansion unless the loads concerned are particularly suitable, e.g. off-peak or high-load factor.

V T

**A79-51960** District heating and cooling with heat pump systems. J. M. Calm and P. T. Bauer (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p. 1681-1686. Research sponsored by the U.S. Department of Energy.

The paper describes basic approaches to district heating and cooling with heat pump systems and the heat-pump-centered integrated community energy systems (HP-ICES) project. HP-ICES are energy systems for communities, which provide heating, cooling and/or other thermal energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources rather than convert it from electrical or chemical to thermal form, HP-ICES offer potential for energy conversion. Furthermore, since conventional building heating and cooling systems would be replaced by this community energy system, nonscarce resources could be used instead of depleting fuels which are in short supply.

V T

**A79-51961** Feasibility of a heat-actuated heat-pump-centered integrated community energy system. B. D. Yudow, N. R. Baker, R. R. Tison (Institute of Gas Technology, Chicago, Ill.), and P. F. Swenson (Consolidated Natural Gas Service Co., Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference,

14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2  
Washington, D.C., American Chemical Society,  
1979, p 1687-1692

The heat-actuated heat pump centered integrated community energy system (HAHP-ICES) is described. In this system, a small, high-efficiency steam turbine is combined with heat pump and thermal distribution technologies to meet the space conditioning needs of an office and residential community with over 30% less energy consumption when compared with conventional space-conditioning systems. The HAHP-ICES system performance was calculated for each hour of the year using a computer simulation program, which incorporated the central plant's performance and operational philosophy. The sensitivity of a base case economic model to changes in discount and interest rates, capital requirements, and operating and maintenance costs was also calculated to test the concept's economic viability. In addition, a sensitivity analysis was performed to assess the effect of climate, and the gas and electric utilities' rate structure. V T

**A79-51962** System performance of a Stirling engine powered heat activated heat pump. W. D. Richards and W. S. Chiu (General Electric Co., Philadelphia, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1693-1698. 5 refs.

The paper presents the results obtained in testing the first prototype of the complete heat-activated heat pump (HAHP) system. The matching characteristics of the subsystem components, especially between the free piston Stirling engine and the free piston linear compressor are described. Optimization of the system matching techniques is outlined. The discussion includes potential improvements in the system performance based on the analytical evaluations and empirical test results of the first prototype. It is noted that an improvement in engine performance represents the most promising area to address in order to yield a more efficient heat activated heat-pump product. An over 30% engine efficiency is predicted for the second prototype. V T

**A79-51963** Modeling the performance of gas-fired heat pump systems. A. Patani and U. Bonne (Honeywell, Inc., Corporate Technology Center, Bloomington, Minn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1699-1705. 14 refs. Research supported by the Gas Research Institute.

The energy performance of gas fired heat pumps for residences has been computer-simulated and the influence of the major factors affecting it has been studied by analyzing operation of various system configurations. The physical elements and assumptions used in the simulation model, including engine and compressor performance vs speed and/or throttle conditions, and waste heat recovery are described in detail. Consideration is given to such factors as engine size, engine efficiency, compressor efficiency, electric consumption, mode of operation, climate, refrigerant circuit features, cycling and crankcase losses, etc. which can affect efficiency and operating costs of a system consisting of an internal combustion engine coupled to a Rankine cycle refrigerant circuit, a heat-recovery unit, and a gas-fired auxiliary furnace. V T

**A79-51964** Heat pump system for process steam generation. R. Sakhuja and G. Milleris (Thermo Electron Corp., Waltham, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1708-1712. Research sponsored by the Southern California Gas Co., Consolidated Natural Gas Co., and Gas Research Institute.

The paper deals with an open-cycle, vapor compression, steam heat-pump system proposed to generate process steam from low-level (less than 500 F) excess industrial heat. The system will normally supply up to 150 psig steam. Excess heat sources as low as 220 F can

be utilized. Fuel savings as high as 70 percent are possible in comparison with direct steam generation using a conventional boiler. Simple payback periods as low as one year can be achieved. A screw compressor is being used as the heat pump. It is capable of pressure ratios of 5 in a single stage and about 16 for two stages. The compressor is driven by a prime mover such as a gas turbine, which generates additional process steam from an exhaust boiler. (Author)

**A79-51965** Thermodynamic evaluation of heat pumps working with high temperatures. I. A. Ekroth (Kungl. Tekniska Hogskolan, Stockholm, Sweden). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1713-1719. 11 refs. Research sponsored by the National Swedish Board for Energy Source Development.

A thermodynamic evaluation of vapor compression heat pumps working with condensing temperatures up to 160 C is presented. In total about thirty different working fluids, refrigerants, are studied. Besides the thermodynamic properties, the thermal and chemical stability must be considered. The cycles examined are basic single stage cycle, two stage cycle with economizer arrangement, and two stage cycle with flash intercooler. In cases where compressor efficiencies are entered into the calculations, values valid for screw compressors are used. The analysis shows that in the most elaborated systems the refrigerants R 12B1, 21, 114, 114a, and 133a are approximately equivalent concerning pressures, coefficients of performance, and swept volumes at condensing temperatures of the magnitude 100 C. For large capacities the specific first cost, including evaporators, condensers, compressors, motors, control equipment, etc., for a well-designed water to water system is expected to be about \$75/kW heating capacity under certain conditions. (Author)

**A79-51966** Technology impact study of a high efficiency industrial heat pump. D. Sullivan (Hittman Associates, Inc., Columbia, Md.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1725-1729. 6 refs. Contract No. EM 78 C-01 4127.

The objective of this study is to determine the economic feasibility, energy conservation potential, and environmental impact of a high efficiency industrial heat pump. The heat pump produces low pressure steam by extracting energy from an industrial waste heat stream. It consists of a compressor section which produces steam, and an organic Rankine cycle heat engine which extracts power for the system's operation directly from the waste heat stream. The system was found to be economically and technically feasible (under certain conditions), have no detrimental environmental or material impact, and it has the potential for saving up to 3 to 4 percent of industrial energy use. (Author)

**A79-51967** Storage assisted heat pumps using phase change materials. G. R. Frysinger (Delaware University, Newark, Del.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D.C., American Chemical Society, 1979, p 1730-1733.

Both the cooling and heating modes of storage-assisted heat pumps using phase change materials are discussed as to proper transition temperatures for phase change materials and the application of thermal energy storage to residential air handling systems. Consideration is given to the following aspects of heat pump system performance: (1) the use of in line thermal-energy storage materials to modify supply/demand time differentials; (2) storage assisted heat pumps in the cooling mode as a summerload management system; (3) the use of storage-assisted heat pumps in the heating mode as a winter-load management technique; and (4) energy efficiency considerations of heat-pump operation with storage. V T



**A79-51968 Waste heat as an alternate fuel - Its opportunities and potential.** W F Adolfson (Booz, Allen and Hamilton, Inc., Bethesda, Md) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1734-1736 8 refs

Recovery of waste heat for further electrical generation, industrial process heat, or space conditioning is discussed. In the near term, waste heat utilization technology and concepts include advanced heat exchangers, cogeneration, heat pumps, and integrated community energy systems. Longer term technology development could make new bottoming cycle systems, thermionic topping cycles, and low-temperature heat engine concepts commercially acceptable. New technology theoretically could save 17 to 25 percent of domestic energy consumption after 1985. V T

**A79-51969 The energy reformation.** A J Cirrito (Lowell, University, Lowell, Mass) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1758-1761 11 refs

Future strategies for producing and distributing domestic and industrial heat and electricity are proposed, emphasizing the necessity of conserving all available and heat energy. Smaller, well dispersed power plants incorporating advanced technology and combined with sewage disposal facilities are discussed as means for controlling pollution and utilizing all available energy and heat generated by fuel combustion. It is suggested that the gain in available energy achieved by combined cycle power plants be used for the transfer of generated heat to fluids involved in domestic and process heating, and a gas turbine heating unit is also proposed as a source of high-pressure gases for heat transfer and utilization. In addition, the necessity of federal support to overcome the short-term economic losses involved in the development and implementation of energy-conserving technology is stressed. A L W

**A79-51970 The concept of available work as applied to the conservation of fuel resources.** E E Michaelides (Brown University, Providence, RI) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1762-1766 15 refs

The purpose of this paper is to analyze the transformations of energy occurring in everyday life in the light of the concept of available work. The utilization factor, based on available work, is then defined and the general problem of fuel savings is schematized in the following form: given a societal task, choose the best alternative process and apply it, with the purpose of minimizing the available work lost, in order to complete the task. (Author)

**A79-51971 Energy research and development at the Canada Centre for Mineral and Energy Technology /CANMET/** G Taylor (Department of Energy, Mines and Resources, Canada Centre for Mineral and Energy Technology, Ottawa, Canada) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1788-1792

The Canada Centre for Mineral and Energy Technology (CANMET), a research and development arm of the federal Department of Energy, Mines and Resources, has a total staff over 700, including 270 scientists and engineers. The research program, which is administered by a matrix management system, is split about equally between energy and minerals, and is a blend of in-house projects, contract research and joint projects. This paper outlines the energy research program, how it is planned, and how it fits in with Canadian national and regional priorities. Selected highlights are described in coal mining, preparation and conversion, cokemaking, combustion technology, oil sands, renewable and nuclear energy, materials, energy storage and transportation, and technical information. (Author)

**A79-51972 Novel approaches to industrial energy conservation in Georgia.** J D Muzzy and J T Sommerfeld (Georgia Institute of Technology, Atlanta, Ga) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1793-1798. Research supported by the Georgia Office of Energy Resources and US Department of Energy.

The operation of the Georgia Industrial Energy Extension Service (IEES) is described, and IEES case studies involving novel approaches to industrial energy conservation are presented. IEES serves as a vehicle of energy conservation technology transfer, conducting plant surveys in the general industrial sector and making recommendations on the ways surveyed plants and similar operations can conserve energy. Approaches suggested by the IEES include the upgrading of low-level waste heat by means of a thermal compressor, the operation of an absorption chiller with dirty boiler exhaust steam, the use of vacuum slots in textile drying, the use of waste sawdust for steam generation, the use of liquified process gases in refrigeration and air conditioning and the development of waste heat or solar-powered refrigeration systems. A L W

**A79-51973 Reference Energy Systems as applied to regional energy policy.** A L Hermelee (Brookhaven National Laboratory, Upton, NY) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1799-1803 6 refs

The energy supply and demand projection methodology of the national-scale Reference Energy System is reformulated for regional energy policy. Residential, commercial, industrial and transportation energy consumption is estimated for a base year and projected for the period between 1985 and 2000 for the regions serviced by the Tennessee Valley Authority and the New York Power Pool. The present and future relative roles of nuclear power, coal, oil, gas and hydropower in supplying energy demand are also assessed. A L W

**A79-51974 Feasibility of energy self sufficiency through decentralized use of renewable resources in Iran.** M Sanai (Arya Mehr University of Technology, Teheran, Iran) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1804-1808

The potential of renewable resources to ensure the future energy self-sufficiency in Iran is assessed. End-use demands for various types of energy in the residential and commercial, agriculture, transport and industrial sectors are estimated for the year 2025 on the basis of 1975 actual data and observed trends for previous years. Energy supplies based on a centralized system of petroleum, natural gas, solid fuel, nuclear and hydroelectric power and on a decentralized system of nuclear, hydroelectric, solar, biomass and wind energy are compared for the two years. It is concluded that Iran has a sufficient amount of indigenous renewable resources to meet energy requirements for further growth even after the depletion of fossil fuel supplies, however strategies should be developed well in advance to ensure a smooth transition. A L W

**A79-51975 Experimental demonstration of heat-to-electricity conversion within a dielectric.** J E Drummond, V Fargo, J Ream, J M Briscoe, and D Brown (Power Conversion Technology, Inc., San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C, American Chemical Society, 1979, p 1819-1824. Research supported by the US Department of Energy.

The conversion of heat to electricity by means of a single-stage Solid State Heat Engine (SSHE) based on a dielectric is reported. In the SSHE, the electro-caloric effect in a ferroelectric is used in an electrical Carnot cycle to produce electrical oscillations with the

addition and extraction of heat pulses by vapor condensation and evaporation in a heat pipe. Several thousand cycles of heat engine operation were found to be accompanied by a power generation of 20 mW, corresponding to an efficiency 80 to 90% of that calculated. Improvements in efficiency, power output and temperature-entropy diagram are expected with the development of computer control and diagnostics and better dielectrics, and multi-stage devices. A L W

**A79-51976 # Solar thermoelectric energy conversion.** D K Benson and T S Jayadev (Solar Energy Research Institute, Golden, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1825-1829. 17 refs. Contract No. EG-77-C-01-4042

The use of thermoelectric energy conversion for solar applications is reexamined in the light of recent improvements in thermoelectric materials and the possible coupling to economical solar collectors. Solar thermoelectric energy conversion is shown to have several technical and possible economic advantages in applications which make use of low cost solar collectors with inherent thermal storage such as solar ponds and ocean thermal gradients. The technical advantages include system simplicity, modularity, mass-producibility, long-life, high reliability, and low maintenance requirements. Correlary economic advantages include the potential low cost of mass-production, low fixed charge rate (assuming long-term depreciation), high availability factor, and low operation and maintenance costs. Two particular applications are discussed: an agricultural irrigation system using a solar pond collector and thermoelectric powered pump, and a large, base load ocean thermal energy conversion system using thermoelectric converters. Preliminary cost estimates indicate that such applications may be economical. (Author)

**A79-51977 Overall efficiency of a cassegrain solar collector using a thermoelectric module to generate electric power.** M H Cobble and E F Thacher (New Mexico State University, Las Cruces, N Mex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1831-1834

A cassegrain solar collector is analyzed to determine the concentration, and augmented concentration. Experimental results of the concentration are shown graphically and compared to the theoretical concentration for a special design. The efficiency of a thermoelectric module is developed when there are convection and radiation losses to the surroundings at the hot plate. The concentration is also shown as a function of the hot plate temperature. (Author)

**A79-51978 Analysis of a heat exchanger - Thermoelectric generator system.** J Henderson (Solar Energy Research Institute, Golden, Colo.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1835-1840

Analysis of a thermoelectric generator (TEG) in an ocean thermal energy conversion (OTEC) application is presented. An analytic model is developed for describing the heat exchanger-TEG interactions. This model is used to illustrate limitations of applying conventional fixed junction temperature assumptions to systems experiencing significant temperature drops across the heat exchanger surfaces. Design methods are developed for determining the thermoelectric element geometry that produces maximum output power. Results show that a heat exchanger-TEG system may deliver about 100 W/sq m of heat exchanger surface. This compares favorably with conventional OTEC schemes. (Author)

**A79-51979 Shock and vibration test program for the MB-M75/A/ radioisotope thermoelectric generator.** J C Bass, S Cheng, N B Elsner, and H G Staley (General Atomic Co., San Diego, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings

Volume 2. Washington, D C, American Chemical Society, 1979, p 1841-1846

A description of the shock and vibration test program conducted to qualify MB M75(A) radioisotope powered thermoelectric generators for field use and the results of those tests are presented. Also included is a synopsis of the structural analysis which preceded the tests. (Author)

**A79-51980 Effective application of thermoelectric heat pumps.** R J Buist (Marlow Industries, Inc., Garland, Tex.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1850-1853

A new system to design, select, optimize, and analyze single-stage thermoelectric heat pumps for cooling applications in the 150 to 400 K range is presented. This method was devised by computer analysis of thermoelectric theory and empirically derived normalized parameters from experience in thermoelectric applications. The maximum efficiency and maximum cooling conditions, the voltage and heat pumping capacity of a pump, the heat pump performance at operational conditions, and the optimum efficiency and cooling conditions are discussed. Application of the derived parameters is illustrated by analysis of a thermoelectric heat pump operating at 300 K heat sink with a delta T of 34 C. It is concluded that the guidelines presented should help the user to select and modify heat pumps to maximize their effectiveness. A T

**A79-51981 \* Thermionic energy converter investigations.** D B Goodale, C Lee, D Lieb, and P E Oettinger (Thermo Electron Corp., Waltham, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1862-1867. 5 refs. Contracts No. JPL-955009, No. EY-76-C-02-3056

This paper presents evaluation of a variety of thermionic converter configurations to obtain improved efficiency. A variable-spacing diode using an iridium emitter gave emission properties comparable to platinum, but the power output from a sintered LaB6 collector diode was not consistent with its work function. Reflectivities above 0.5 were measured at thermal energies on oxygenated-cesiated surfaces using a field emission retarding potential gun. Performance of converters with structured electrodes and the characteristics of a pulsed triode were studied as a function of emitter, collector, cesium reservoir, interelectrode spacing, xenon pressure, and pulsing parameters. A T

**A79-51982 ZEPO - The worlds largest thermionic converter.** L L Begg and G O Fitzpatrick (Rasor Associates, Inc., Sunnyvale, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C, American Chemical Society, 1979, p 1868-1874. 5 refs. Research supported by the U S Department of Energy

The design and testing of the first high current thermionic heat exchanger (THX) and the capabilities of the high current converter test facility (HCCTF) are presented. THX's were shown to increase power plant efficiency up to 50%, or more, when used as topping units, and the first converter in a series of large converters was successfully tested at currents up to 6500 amperes without detrimental effects from magnetic fields. A typical THX module, the thermionic energy conversion process, the HCCTF facility capable of providing large amounts of thermal input power over a wide emitter temperature at high power densities, a gas fired furnace used as the heat source, a jet impingement cooling system used for heat rejection, and the instrumentation system are described. The converter configuration, including the emitter, collector, current lead region, and igniters, converter fabrication, and testing were discussed. It was concluded that the peak current of 6500 amperes and emitter

temperature of 1450 K were limited by furnace operation, and that it was demonstrated that large thermionic converters can be stably operated and easily controlled  
A T

**A79-51983**      **Design study of a coal-fired thermionic-topped powerplant using an advanced boiler.** G Miskolczy (Thermo Electron Corp., Waltham, Mass.) and A E Margulies (Stone and Webster Engineering Corp., Boston, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2      Washington, D C., American Chemical Society, 1979, p 1875-1879 17 refs Contract No EY-76-C-02-3056

This paper examines the engineering and economic feasibility of a thermionic topped advanced boiler fired with pulverized coal. The thermionic emitters in an advanced boiler operate at elevated temperatures with resulting high-output power density and efficiency. The advanced coal fired thermionic-topped system, the configuration of the thermionic boiler and its thermal performance, and plant components, such as the steam-turbine and the air preheater are described. At high operating temperatures, the molten slag runs down boiler walls and collects at the bottom. The efficiency of the thermionic-topped plant operating in the slagging mode was 41% vs 33% for the conventional untopped coal-fired plant, but the efficiency of the thermionic-topped plant using solvent refined coal was estimated to be 47%. It was concluded that an 800 MW coal-fired plant operating in a slagging mode would be economically feasible  
A T

**A79-51985 \***      **NEP heat pipe radiators.** D M Ernst (Thermacore, Inc., Leola, Pa.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2      Washington, D C., American Chemical Society, 1979, p 1886-1889 Contract No NAS7-100

This paper covers improvements of heat pipe radiators for the thermionic NEP design. Liquid metal heat pipes are suitable as spacecraft radiator elements because of high thermal conductance, low mass and reliability, but the NEP thermionic system design was too large and difficult to fabricate. The current integral collector-radiator design consisting of several layers of thermionic converters, the annular-tangential collector heat pipe, the radiator heat pipe, and the transition zone designed to minimize the temperature difference between the collector heat pipe and radiator heat pipe are described. Finally, the design of micrometeoroid armor protection and the fabrication of the stainless steel annular heat pipe with a tangential arm are discussed, and it is concluded that the heat rejection system for the thermionic NEP system is well advanced, but the collector-radiator heat pipe transition and the 8 to 10 m radiator heat pipe with two bends require evaluation  
A T

**A79-51986 \***      **Recent progress in hybrid mode thermionic converter development.** K Shimada (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2.      Washington, D C., American Chemical Society, 1979, p 1890-1893 Contract No NAS7-100

Thermionic research has been conducted to investigate a hybrid-mode thermionic converter as a candidate for reducing the barrier index. The hybrid-mode thermionic converter is designed to operate in a combination ignited mode and unignited mode by using a series of parallel grooves in the emitter. The emitter material is molybdenum and the non-grooved land area is thinly coated with rhenium metal. When the emitter is exposed to cesium vapor, as it is during the converter operation, the rhenium-coated land area achieves a lower work function than the grooved molybdenum surface by as much as 0.5 eV. The low work function land area provides a major portion of electron emission, and the high work function grooved area provides cesium ions required for efficient

transport of electrons generated in adjacent land areas to the collector. Experimental results obtained from two different converters and a numerical analysis of converter characteristics are presented in this paper  
(Author)

**A79-51988**      **Flame-fired thermionic diode development.** F N Huffman, B. Gunther, and G Miskolczy (Thermo Electron Corp., Waltham, Mass.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2      Washington, D C., American Chemical Society, 1979, p 1899-1903 7 refs Contract No EY-76-C-02-3056

The construction and testing of combustion-heated thermionic diodes using a hot shell made of available materials to protect the converter are presented. The combustion diode development to flame-heated converters with fixed spacing, the quarter scale devices for evaluation of electrode materials and configurations, prototypic designs using Inconel 671 and ceramic-to-metal seal geometry, and the cesium-graphite reservoir, which provides the optimum cesium pressure in the converter at the operating temperature of the collector are described. It was found that (1) the output power densities of present thermionic-diodes, operated with the temperature limitations of alloy hot shell materials are less than 1.0 W/sq cm, (2) the output characteristics of the flame-heated thermionic converters correlate with electron-bombardment-heated research diodes, and (3) Inconel 671 can be used as a hot shell up to 1450 K for 2000 hr. It was concluded that the feasibility of a thermionic converter with a cesium-graphite reservoir was demonstrated at conditions corresponding to topping a central station powerplant  
A T

**A79-51989**      **State of cermet electrode development for flame heated thermionic converters.** M von Bradke and R Henne (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2      Washington, D C., American Chemical Society, 1979, p 1904-1907 5 refs

Development of new types of cermet electrodes made of ZrO<sub>2</sub> and molybdenum or tungsten for flame heated thermionic converters is presented. The fabrication of these electrodes by sintering can be optimized to obtain densities up to 92%. Thermionic emission measurements showed somewhat lower emission current maxima and also lower values of minimum work function down to 1.2 eV, indicating their applicability for collector application. Tests of flame heated thermionic diodes equipped with emitters of this new material showed a considerable high emission current density of more than 20 A/sq cm at 1200 C, but also a low output voltage indicating a low emitter function at operating conditions. It was concluded that further optimization of electrode composition and operating conditions is required to improve output power and efficiency  
A T

**A79-51990**      **The effects of electron thermal conductivity on thermionic energy converters.** S H Lam (Princeton University, Princeton, N J.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2      Washington, D C., American Chemical Society, 1979, p 1908-1911 Contract No AT(11-1)2533

The present work presents an analytical theory focusing on the electron energy equation. It is shown that the ratio of electron thermal conductivity to the electron mobility (properly non-dimensionalized) is an important parameter. When this parameter is large, the theory reduces to the well-known isothermal theory. When this parameter assumes physically reasonable values, the theory indicates that a different physical mechanism is controlling the magnitude of the plasma arc-drop, and generally degrades the converter performance from that predicted by the isothermal theory. Even though the basic development assumes a steady state and a one-dimensional model, but because of the analytical nature of the present theory, reasonable generalizations and extrapolations can be

made. Implications of the present results to current arc-drop reduction schemes will be discussed (Author)

**A79-51991 # Open-cycle coal-fired liquid-metal MHD.** E S Pierson, M Petrick, F Schreiner, D Cohen, and R S. Smith (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1912-1917 7 refs Contract No W-31-109-eng 38

Open-cycle, coal-fired, liquid-metal MHD is described and compared with the open-cycle plasma MHD cycle, and it is shown that, in the former, temperatures are much lower and an air preheater and radiant boiler are eliminated. The constraints on electrodynamic working fluid and the choice of copper are discussed. Initial efficiency calculations yield values comparable to those for open-cycle plasma MHD at combustor temperatures more than 1000 K lower and MHD generator temperatures more than 1000 K lower than is the case for open-cycle plasma MHD. It is noted that liquid-metal MHD systems can use components that, except for the generator, are close to or within present-day technology. V T

**A79-51992 Considerations for adapting an MHD baseload power plant for intermediate and peaking duty.** W R Owens, V B Mantri, N T Truncellito (Gilbert/Commonwealth, Reading, Pa.), and J J Lynch (U S Department of Energy, MHD Div., Washington, D C.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1918-1922 11 refs

The paper studies potential modifications to a commercial MHD topping/steam bottoming baseload coal fired power plant which permit intermediate and peaking multiduty capability. These modifications are attained by increasing the power output of a baseload plant through operation at less than optimum baseload economic conditions. The output power of an MHD baseload plant can be increased by using oxygen enriched combustion air, increasing the combustion air preheat temperature, or increasing the seed flow. Of these three options, oxygen enrichment offers the greatest potential for intermediate duty operation. Because the temperature of the combustion gas changes considerably with oxygen enrichment, finite temperature ramps have to be designed into the control system to prevent thermal shocks to the system. V T

**A79-51993 Environmental assessment of a coal-fired open-cycle MHD power plant.** C D Kalfadelis, D W Blair, H Shaw (Exxon Research and Engineering Co., Linden, N.J.), B A Folsom, and T L Corley (Energy and Environmental Research Corp., Irvine, Calif.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1923-1930 17 refs

The environmental effects of a conceptual open-cycle MHD power plant fueled with Illinois No. 6 bituminous coal are evaluated. Equilibrium combustion gas properties are calculated in the various components of the plant, and kinetic calculations are made for NOx production. Both NOx and particulate emissions are found to meet the New Source Performance Standard (NSPS) for large power plants. The quantity of stack gas sulfur emissions is estimated for two cases. The potential sulfur emissions for a seed regeneration case are below the current NSPS. The second case assumes that once-through fuel-gas desulfurization is used for SOx control and that K2SO4 is recycled as seed. The fuel-gas desulfurization case met the current standard using a limestone scrubber that removes 80% of the sulfur entering with the coal. V T

**A79-51994 Operability and materials testing for MHD air heaters.** D F Saari, R R Smyth, C J Kniebel, and L R White (Fluidyne Engineering Corp., Minneapolis, Minn.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2

Washington, D C., American Chemical Society, 1979, p 1931-1938 14 refs Contract No ET 78-C-01 3005

The experimental program and test facilities for MHD heater development are described. Significant results with respect to heater operability and materials performance are shown. Stable air heater operation and removal of seed/slag deposits have been demonstrated in a test facility. Fusion cast magnesia spinel has been identified as a candidate material for full-scale air heaters and is now being subjected to long term evaluation. (Author)

**A79-51995 \* # Performance optimization of an MHD generator with physical constraints.** C C P Pian, G R Seikel, and J M Smith (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1939-1944 7 refs

A technique has been described which optimizes the power out of a Faraday MHD generator operating under a prescribed set of electrical and magnetic constraints. The method does not rely on complicated numerical optimization techniques. Instead the magnetic field and the electrical loading are adjusted at each streamwise location such that the resultant generator design operates at the most limiting of the cited stress levels. The simplicity of the procedure makes it ideal for optimizing generator designs for system analysis studies of power plants. The resultant locally optimum channel designs are, however, not necessarily the global optimum designs. The results of generator performance calculations are presented for an approximately 2000 MWe size plant. The difference between the maximum power generator design and the optimal design which maximizes net MHD power are described. The sensitivity of the generator performance to the various operational parameters are also presented. (Author)

**A79-51996 Ball screw type wave power generator.** K I. Ohmata and H Shimoda (Meiji University, Kawasaki, Japan) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1946-1951 7 refs

To obtain an even flow of electric power from fluctuating wave energy, the authors devised a ball screw type wave power generator (BSTWPG) which consists of a pressure plate, ball screws and nuts, one-way clutches, flywheels and generators. The equations of motion of the BSTWPG system are shown and the digital simulation using Continuous System Simulation Language is developed on the assumption that the wave force is sinusoidal. The experimental model is composed of a ball screw of outside diameter 22 mm and a flywheel having moment of inertia of 2.5 kgf sq cm. When this model was subjected to the sinusoidal motion of amplitude 17 mm and frequency 0.7 Hz by a vibration table, six 6 volts - 6 watts bulbs were lighted up. In this case, the rotating speed of the flywheel changed within the range of 490-590 rpm. (Author)

**A79-51997 Feasibility and economics of salinity power using Osmo-Hydro Power.** G D Mehta, S Loeb, and M D Fraser (Inter Technology/Solar Corp., Warrenton, Va.) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings. Volume 2 Washington, D C., American Chemical Society, 1979, p 1952-1957 8 refs Contracts No EG-77-G-01-4066, No EG-77-C-05-5560

The technical feasibility and economic performance of salinity power using Osmo-Hydro Power (OHP) systems are studied. The results of two projects are reported which were completed for the DOE. Under one project, laboratory experiments were done to investigate the technical feasibility of such a system. The second project was concerned with the performance and economics of OHP systems utilizing various sources of salt and water. The cost of electricity produced by a 1 MW OHP system is estimated to be about \$0.33/kWh. Desired characteristics of the pressure-retarded osmosis membrane used in the system and different configurations of an OHP system are discussed. V T

**A79-51998** Temperature profile and power calculations in gas core reactors C B W Kerkdijk and J Kistemaker (Stichting voor Fundamenteel Onderzoek der Materie, Instituut voor Atoom- en Molecuulfysica, Amsterdam, Netherlands) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 1958-1961 6 refs

This paper deals with the calculation of the temperature profile and the power of a gas core reactor Starting with the continuity equation and the equation for the radiative energy transport and the thermal heat conduction, a simple differential equation is obtained The Uniform Density Diffusion Model (UDDM) is introduced which enables a first order estimate of the temperature and the power of a gas core reactor The results of this model are in good agreement with calculations of Stoescu (Author)

**A79-51999 #** Performance characteristics of a type of electrohydrodynamic generator T H Gawain and O Biblarz (U.S. Naval Postgraduate School, Monterey, Calif) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 1962-1967 7 refs

An electrohydrodynamic power generator which employs an ejector and a so-called 'fluid flywheel' is analyzed The medium is steam containing charged water droplets Account is taken of the empirical fact that the maximum electrical field strength that can be sustained is proportional to the fluid density It is shown, therefore, that the electrical output can be maximized by designing the primary jet for an exit Mach number of 0.71 Estimates are made of the pump work required, of mixing losses in the ejector and of friction and secondary flow losses Key dimensionless parameters that govern performance are clearly identified Overall performance of the system is estimated and, unfortunately, pessimistic results are obtained They indicate that even at 100 atmospheres, the power output is so limited that it is probably insufficient to cover the demand for pump power and to overcome the various losses involved A hopeful note is that the analysis so clearly pinpoints the problem that it might suggest the means for surmounting it (Author)

**A79-52000** Increasing gas turbine efficiency through the use of a waste heat methanol reactor C W Janes (California Energy Commission, Sacramento, Calif) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 1968-1972 6 refs

The paper discusses generating of additional power from the exhaust heat of a gas turbine through the use of a waste-heat methanol reactor With the advent of methanol as an available turbine fuel, waste heat can be recuperated as chemical energy by means of endothermic reactions and redeemed as high grade thermal energy in a combustor The modification of a simple-cycle gas turbine by the addition of a catalytic waste-heat methanol reformer shows the 23% decrease in fuel cost An overall coal-to-methanol-to-electricity conversion efficiency of 42% in the near term appears attainable V T

**A79-52002** The energy exchanger in advanced power cycle systems J F Zumdick, W J Thayer, P E Cassidy, R T Taussig (Mathematical Sciences Northwest, Inc., Bellevue, Wash), W H Christiansen, and A Hertzberg (Washington, University, Seattle, Wash) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 1979-1984 6 refs Contract No ER-78-C-06-1034

Energy exchanger technology becomes more complex as the pressure and temperature ratios over which they operate increase The paper analyzes an energy exchanger applied to an advanced power cycle system A configuration is selected which allows direct comparison with high-temperature turbine systems currently under

development for the same application A description of experiments currently in progress to substantiate the relevant scaling laws is also presented The results indicate that the energy exchanger represents an alternative to the difficult development of high temperature turbine blade technology S D

**A79-52005** Development of CDE /Concentration Difference Energy/ system and engine N Ishiki, M Takeuchi (Tokyo Institute of Technology, Tokyo, Japan), I Nikai (Ishikawajima Harima Heavy Industries Co., Ltd, Yokohama, Japan), J Kamoshida (Shibaura Institute of Technology, Omiya, Japan), and T Akuta (Nippon Steel Corp, Tokyo, Japan) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 1998-2003

In this paper, the recent developments of the CDE (Concentration Difference Energy) system and engine are reported This system offers a kind of general method of energy conversion, storage and utilization of thermal and mechanical energy of alternative resources such as solar, oceanic heat and wind power using cyclic change of concentration of solvent in any solutions An aqueous solution of  $\text{CaCl}_2 + \text{LiCl}$  is selected as the most suitable solution, and a nickel-copper alloy of low nickel content is selected to be the best anti-corrosive material A manned tri-wheel CDE car is driven for more than 15 minutes, and an experimental 1 kW CDE engine is successfully tested Future application of this CDE system, including power recovery from industrial waste heat and power generation from saline energy resources, are also proposed (Author)

**A79-52006** Electromagnetic launchers H Kolm, K Fine, P Mongeau, and F. Williams (MIT, Cambridge, Mass) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 2004-2012 27 refs Grant No DAAG29-78-G-0147

The paper summarizes the preliminary results of a cooperative effort aimed at providing national coordination for a new project of applying pulsed electric power to a variety of propulsion tasks The state of the art of energy storage for gun and launch applications is surveyed A novel system is described which is the momentum transformer that transfers momentum from a massive chemically propelled armature to a much lighter, higher-velocity projectile by magnetic flux compression Potential applications are briefly outlined S D

**A79-52007** R and D on Rankine cycle engines in Japan N Ishiki (Tokyo Institute of Technology, Tokyo, Japan) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 2017-2022 5 refs

This report describes R&D in Japan on power recovery from industrial waste heat and other alternative energy resources as geothermal and solar heat, with studies and experiments on the utilization of organic Rankine cycle engines reported on in detail In Japan, many governmental and private R&D projects are underway for new energy techniques such as the 'Sunshine Project', the 'Moonlight Project', and JSME's similar study project The organic Rankine cycle is thought to be one of the most important and promising methods for power generation from low density thermal energy resources, and much effort has been made in its development (Author)

**A79-52008** R & D on advanced heat exchangers in Japan I Tanasawa (Tokyo, University, Tokyo, Japan) In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass, August 5-10, 1979, Proceedings Volume 2 Washington, D C., American Chemical Society, 1979, p 2023-2027 14 refs

A state-of-the-art review is presented for the R&D of heat exchangers in Japan, with special emphasis on devices designed for effective thermal-energy use. A description is given of high-efficiency heat transfer surfaces which are essential to the improvement of heat exchangers. Porous metal surfaces, microstructural surfaces, and several types of finned surfaces are considered. Some examples of advanced heat exchangers in Japan are provided. S D

**A79-52009** Research and development on ocean thermal energy conversion in Japan. H Uehara (Saga University, Saga, Japan). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C., American Chemical Society, 1979, p. 2028-2034. 9 refs.

In this paper, review of OTEC R&D activity in Japan and proposal of OTEC R&D program is made. In Japan, a feasibility study on OTEC power plant has been conducted under the leadership of a team of 'Sunshine Project', a national new energy development project promoted by the Ministry of International Trade and Industries (MITI) since 1974. OTEC Committee carries out the studies on the key problems of OTEC plant: working fluid, heat exchangers, turbines, platform, cold water pipe and assessment of environmental effects. Conceptual design and economical evaluation on a 100 MWe OTEC commercial scale power plant have been carried out and the results obtained there show electric generating cost is comparable to conventional power cost. Tests on the characteristics of OTEC power system have been conducted by ETL of MITI and Saga University. (Author)

**A79-52010** Japan's national project - Development of high temperature gas turbine-steam turbine combined cycle plant for community cogenerating energy system. M Hirata (Tokyo, University, Tokyo, Japan). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C., American Chemical Society, 1979, p. 2039-2044. 5 refs.

The paper outlines the government-sponsored Moon-Light Project, with particular reference to the development of a community cogenerating energy system which integrates a high-temperature gas turbine-steam turbine combined cycle plant. This combined cycle engine makes it possible to utilize heat throughout a wide range of temperatures, from the exhaust gas of the gas turbine (above 600 C) to steam or hot water. It is possible to utilize this high-temperature exhaust gas for preheating or thermal decomposition of urban refuse, and the steam or hot water is used for the heat sources of industrial processes or district heating and cooling. This combined cycle engine is expected to become the core plant of the so-called Community Energy System (CES). Examples of CES design are given. S D

**A79-52012** Wind tunnel tests of a 1/30 scale model of a 3.5 megawatt wind turbine. H S Wainauski (Hamilton Standard, Windsor Locks, Conn.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C., American Chemical Society, 1979, p. 2050-2058. 7 refs.

Results are presented for wind tunnel tests of a 1/30 scale model of a 3.5-MW wind turbine (wind energy conversion system). The model measures 2.44 m in diameter, with two aluminum blades of 37.5 activity factor. The effects of scale, blade surface roughness, blade inboard planform, and airfoil modifications are assessed. The results indicate that the measured performance of the model wind turbine, adjusted for scale effects, is within 1% of the predicted performance of the full-scale wind turbine when compared on an annual energy output basis for the 3.5 MW rating. Valuable photographs of the trailing wake are obtained to provide a basis for an improved analytical model to the wind turbine aerodynamic method. S D

**A79-52013** The zinc-chlorine battery in the BEST facility 1981. C C Whittlesey, P C Symons, C J Warde, and B D

Brummet (Energy Development Associates, Madison Heights, Mich.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2.

Washington, D C., American Chemical Society, 1979, p. 2059-2064. 5 refs. Research supported by the U S Department of Energy and Electric Power Research Institute.

The paper outlines the specifications, design and operation of a 5-MW zinc-chlorine hydrate battery system, to be placed in the battery energy storage test (BEST) facility by mid-1981. The preliminary design makes use of 100 battery modules (arranged in five racks), each delivering 52 kWh at an electrochemical energy efficiency of 65%. A refrigeration subsystem that allows chlorine hydrate formation during charge, and a hierarchical controller complete the battery system. A successful test at the BEST facility will result in commissioning a 100-MW zinc-chlorine hydrate demonstration plant within the 1982-1984 period. S D

**A79-52014** Solar refrigeration utilizing zeolites. D I Tchernev (Zeopower Co., Natick, Mass.). In Intersociety Energy Conversion Engineering Conference, 14th, Boston, Mass., August 5-10, 1979, Proceedings Volume 2. Washington, D C., American Chemical Society, 1979, p. 2070-2073.

Zeolites offer a unique opportunity for a solid-gas adsorption refrigeration system because of their unusual sorption properties, in particular, extremely nonlinear adsorption isotherms. The operating principle of the zeolite system and experimental results are presented. The study demonstrates a zeolite system capable of providing refrigeration and ice production with very good engineering efficiency. This system utilizes natural zeolites as the solid adsorber and water vapor as the working fluid, to produce on a sunny day two pounds of ice per each square of solar zeolite collector. S D

**A79-52026** Electrogenative and voltametric processes. S H Langer and G P Sakellariopoulos (Wisconsin, University, Madison, Wis.). In *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 18, Oct. 1979, p. 567-579. 119 refs. Research supported by the Du Pont de Nemours and Co., Union Carbide Corp., Atlantic Richfield Co., University of Wisconsin, and NSF.

Electrogenative processes are explained and reviewed and compared with conventional electrochemical and heterogeneous catalytic processes. These processes exploit favorable reaction thermodynamics to recover byproduct electric energy while a useful chemical is produced. Factors and considerations involved in the design and operation of electrogenerative reactors are also discussed. Electrochemical operation often is extended to previously unexplored electrochemical potential regions and selectivity may be altered. Ready control of reaction rate with the removal of energy, in a useful form, and creation of favorable reaction conditions make the electrogenerative mode attractive for some highly exothermic reactions. Related voltametric processes for endothermic changes also are defined and their advantages explained and illustrated. (Author)

**A79-52027** # Evaluation of use of syngas for coal liquefaction. R F Batchelder and Y C Fu (U S Department of Energy, Pittsburgh Energy Technology Center, Pittsburgh, Pa.). In *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 18, Oct. 1979, p. 594-599. 8 refs.

Coal liquefaction processes by direct catalytic liquefaction or extractive hydrogenation could benefit economically by using syngas in place of hydrogen. Data are presented to show that the hydrotreating of bituminous coal using syngas and steam with Co-Mo-K<sub>2</sub>CO<sub>3</sub> catalyst gave product oil similar to that obtained from the hydrotreating using H<sub>2</sub> and Co-Mo catalyst. A comparative process evaluation has been made for the direct catalytic liquefaction of coal using H<sub>2</sub> and syngas. Summaries of mass balance, energy balance, and cost estimation are presented. The use of syngas reduces the capital and operating costs by eliminating shift converters and gas purifying systems and thus could reduce the process cost of SYNTHOIL and H-coal by about 14%. The process economics could

be further improved by the use of a high-pressure coal gasification process for the syngas production. (Author)

**A79-52028**      **Entrainment coal gasification modeling.** C Y Wen and T Z Chaung (West Virginia University, Morgantown, W Va) *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol 18, Oct 1979, p 684 695 26 refs Contract No E(49-18)-2274

A mathematical model is developed to simulate the Texaco downflow entrainment pilot plant gasifier using coal liquefaction residues and coal-water slurries as feedstocks. The entrainment gasifier was conceptually divided into three zones: the pyrolysis and volatile combustion zone, the gasification and combustion zone, and the gasification zone. Temperature and concentration profiles along the reactor were obtained by solving the material and energy balances and taking into consideration the gasification kinetics, the transport rates, and the hydrodynamics of the gasifier. The results of computation from the proposed model were compared with the experimental data. Sensitivity of the parameters used in the model was tested and optimum operating conditions were searched to provide a better understanding of the performance under various operating conditions utilizing the model. (Author)

**A79-52150**      **Spectrally selective solar absorber coatings.** M G Hutchins (University College, Cardiff, Wales) *Applied Energy*, vol 5, Oct 1979, p 251-262 21 refs

The paper presents a review of the physical processes responsible for spectral selectivity in solar absorber coatings. It is noted that solar absorber coatings may be categorized as either selective, solar absorptance high, thermal emittance low, or as nonselective, solar absorptance high and thermal emittance high. It is shown that the physical processes which contribute to the absorptance and emittance properties of thin-film coatings are complex and in most finishes selectivity is a result of two or more of these processes acting in tandem. Examples of common coatings are surveyed and the durability requirements of coatings are assessed and a summary of techniques of surface analysis is given. M E P

**A79-52166**      **A cesium vapor source based on a gas-regulated heat pipe for thermionic energy transducers.** (Istochnik parov tseziia na osnove gazoreguliruemoi teplovoi trubki dlia termionnykh preobrazovatelei energii) I G Gverdtsiteli, A G Kalandarishvili, and P D Chilingarishvili. *Zhurnal Tekhnicheskoi Fiziki*, vol 49, Aug 1979, p 1764, 1765 7 refs. In Russian

**A79-52167**      **Results of an experimental investigation of a low-temperature thermionic converter with an expanded collector.** (Nekotorye rezul'taty eksperimental'nogo issledovaniia nizkotemperaturnogo TEP s razvitym kollektorom) I G Gverdtsiteli, N E Menabde, V K Tskhakalaia, and L M Tsakadze. *Zhurnal Tekhnicheskoi Fiziki*, vol 49, Aug 1979, p 1766, 1767. In Russian

**A79-52307**      **Coatings for enhanced photothermal energy collection. I - Selective absorbers.** C M Lampert (California, University, Berkeley, Calif) *Solar Energy Materials*, vol 1, June-Aug 1979, p 319-341 65 refs. Research supported by the U.S. Department of Energy

For economical and efficient utilization of solar energy various types of absorber coatings and preparations can be used for solar collectors. In this study several varieties of commercial and research selective absorbers are reviewed and tabulated for application. For many of these coatings, detailed reflectance, emittance and thermal stability data are presented. Selective coatings can take advantage of various optical absorption methods including light trapping, particulate coatings, semiconductor-metallic layers, multilayer films, quantum size effects and intrinsic absorption. The results of this study revealed many promising low temperature (150-300 C) absorber coatings along with a few highly engineered coatings which can withstand temperatures above 500 C. (Author)

**A79-52308**      **Materials aspects of photo-electrochemical systems.** D Cahen, J Manassen, and G Hodes (Weizmann Institute of Science, Rehovot, Israel) *Solar Energy Materials*, vol 1, June-Aug 1979, p 343 355 26 refs. Research supported by the U.S. Israel Binational Science Foundation

This paper discusses materials aspects of photo electrochemical systems which are common to photovoltaic and electrochemical cells. Photocorrosion occurs which is dependent on the reaction rate between light generated charge carriers and solution species, and the removal rate of reacted solution species from the electrode surface. Prevention of photocorrosion, the choice of a substrate material, and the materials problems of the counter electrode and the photo electrochemical storage cell are discussed. When chemicals are produced, the energy difference between the bandgap of the semiconductor and the photopotential obtained can be used to overcome overpotentials, which is of special importance for photo diodes. It is concluded that while the combination of energy production, energy storage, and the production of chemicals into one device creates technical problems, it may be more economical as has been shown for similar cases in chemical technology. A T

**A79-52309**      **CVD molybdenum thin films in photothermal solar converters.** G E Carver (Arizona, University, Tucson, Ariz) *Solar Energy Materials*, vol 1, June-Aug 1979, p 357-367 17 refs. Contract No EY 76-S 04 3709

Molybdenum thin films deposited by pyrolytic decomposition of molybdenum carbonyl attain, after anneal in a reducing atmosphere at 1000 C, infrared reflectance values within 0.7% of the reflectance of supersmooth bulk molybdenum. This result combines the refractory nature of molybdenum with the high infrared reflectance generally associated with conventional mirror materials. The entire production sequence proceeds at one atmosphere pressure and requires less than one hour. Films deposited under oxidizing conditions exhibit a solar absorptance of  $a = 0.77$  and a thermal emittance of  $e = 0.44$ . Absorptances of  $a = 0.82$  with  $e = 0.08$  are obtained by first annealing and then overcoating these black molybdenum films with an antireflecting layer. Changes in the optical properties during annealing are related to compositional and structural properties of the films, as determined by X-ray diffraction, electron microscopy and Auger spectroscopy. (Author)

**A79-52311**      **Structure identification and optical and electrical properties of cuprous sulphide layers in relation with solar energy application.** F Arjona, E Elizalde, E García-Camarero, A Feu, B Lacal, M León, J Liabrés, and F Rueda (Madrid, Universidad Autónoma, Madrid, Spain) *Solar Energy Materials*, vol 1, June-Aug 1979, p 379-386 9 refs. Research supported by the Comisión Asesora Científica y Técnica, NSF Grant No O1P-75-20264

**A79-52312**      **Temperature variation of the absorption edge of CVD amorphous and polycrystalline silicon.** M Janai and B Karlsson (Arizona, University, Tucson, Ariz) *Solar Energy Materials*, vol 1, June-Aug 1979, p 387-395 12 refs. Research supported by the Technion-Israel Institute of Technology, Contract No ER-78-S-02-4899

Amorphous silicon films were prepared by the pyrolytic decomposition of silane (CVD). Their optical reflectance and transmittance in the near-infrared and in the visible regions were measured at temperatures between -25 and 500 C. Optical absorption profiles and refractive indices of the films were calculated, and the thermal red shift of the absorption profile was determined. These measurements were repeated following crystallization of the silicon films. The significance of the results for thermal conversion of solar energy with CVD silicon as the absorbing material is discussed. (Author)

**A79-52313**      **Inhomogeneous surfaces as selective solar absorbers.** R B Stephens and G D Cody (Exxon Research and

Engineering Co., Linden, N.J.) *Solar Energy Materials*, vol 1, June-Aug 1979, p 397-410 28 refs

The purpose of the present study is threefold (1) to describe a unified treatment of the optical properties of inhomogeneous surfaces, (2) to use the treatment to generate benchmark optical standards and to compare them to achievable surfaces, and (3) to show how this treatment can then be used to derive criteria for the development of new surfaces. The discussion covers modeling, specular reflectance, diffuse reflectance and total reflectance. It is shown that the optical properties of such surfaces are largely independent of the details of their topologies, and that they can be described with only two parameters - surface depth and correlation length. The calculations provide a new insight into the operation of the currently selective surfaces and define a bench mark against which their performance can be evaluated. S D

**A79-52314** A study of oxide-based heterostructure photoelectrodes H P Maruska and A K Ghosh (Exxon Advanced Energy Systems Laboratory, Linden, N.J.) *Solar Energy Materials*, vol 1, June-Aug 1979, p 411-429 24 refs Contract No EG-77-C-024271

A review of the literature of solar-driven water photoelectrolysis cells employing semiconductor electrodes revealed that all devices tested suffered from three major problem areas: corrosion, poor sunlight absorption and external bias requirement. Only certain oxides are stable, but they are not good absorbers of sunlight and require biasing arrangements. The correlation between the external bias requirement and electron affinity of oxides was identified. A series of composite electrodes comprised of a stable wide band gap oxide ( $\text{TiO}_2$ ,  $\text{SrTiO}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{SnO}_2$ ) and a corrosion prone sunlight absorber ( $\text{CdS}$ ,  $\text{CdSe}$ ,  $\text{ZnTe}$ ,  $\text{Si}$ ) were fabricated and tested. Performance of heterostructure electrodes was shown to be limited either by pin hole problems or by potential barriers between the valence bands. These potential barriers can be minimized by using insulating oxide samples, with high work functions, and the photovoltaic properties of insulating  $\text{SrTiO}_3$  are presented. (Author)

**A79-52316** Hydrogen and electricity from water and light - A lanthanum chromite-titanium dioxide anode. V Guruswamy and J O'M Bockris (Texas A & M University, College Station, Tex.) *Solar Energy Materials*, vol 1, June-Aug 1979, p 441-449 Research supported by the South Australian Energy Committee

A photo-active anode involving lanthanum chromite has been studied. The electrodes were made by firing lanthanum and chromium oxides, or salts which are converted upon heating to the oxide, in a paste of citric acid on a titanium oxide base. The anodic photo currents obtained were around four times greater than on an  $\text{TiO}_2$  single crystal in the same potential region on a conventional scale. The photoelectrochemical spectrum showed a pronounced and characteristic peak which differed markedly in wave length region from that on  $\text{TiO}_2$ . The efficiency of conversion of solar light at a  $\text{LaCrO}_3\text{-TiO}_2$  electrode is at least one order of magnitude greater than on  $\text{TiO}_2$ . Hence, the situation for photo-assisted electrolysis is improved. In self-generating photo-electrolysis cells in solar light, the expected efficiency of conversion is calculated to be about one order of magnitude more than the hitherto most efficient couple,  $\text{GaP-TiO}_2$ . The efficiency of hydrogen production from solar light is expected to be about 1.8% (up from 0.2175%), but the implication for the use of transition metal oxides for photo anodes is encouraging. (Author)

**A79-52317**  $\text{Cu/1-yAg/yInS}_2\text{1-xSe/2x/}$  as a prototype of the pentenary chalcopyrite semiconductor system for solar photovoltaic cells G H Chapman, J Shewchun, B K Garside (McMaster University, Hamilton, Ontario, Canada), J J Loferski, and R Beaulieu (Brown University, Providence, R I) *Solar Energy Materials*, vol 1, June-Aug. 1979, p 451-469 27 refs Research supported by the National Research Council of Canada, Contract No EG-77-C-03-1979

**A79-52319** High absorptivity Al-PbS selective surfaces for solar photothermal conversion B K Gupta, R Thangaraj, and O P

Agnihotri (Indian Institute of Technology, New Delhi, India) *Solar Energy Materials*, vol 1, June-Aug 1979, p 481-487 6 refs

Low-cost two-layer Al-PbS selective coatings for solar photo-thermal conversion have been produced by a chemical deposition process. The Al-PbS coatings are stable at room temperature and have good adhesive properties. When cycled between room temperature and 120 C, the coatings suffer no change in their spectral absorptance. The coatings have high absorptivity in the solar spectral region (0.93) and low emittance in the infrared region (0.21). The selective coatings gave a stagnation temperature of 120 C. Ultraviolet irradiation in air caused oxidation of the sulfide to sulfate. No such effect was seen upon UV treatment in vacuum. Chemically sprayed two-layer Al-PbS provides a low-cost selective coating for solar photothermal conversion. An apparatus for measuring the normal emittance of solar selective coatings and low emittance metallic substrates over the temperature range 25 to 250 C to an accuracy of  $\pm 0.01$  has been described. (Author)

**A79-52321** Minority carrier lifetimes in silicon solar cells determined from spectral and transient measurements H T Weaver and R D Nasby (Sandia Laboratories, Albuquerque, N Mex.) *Solid-State Electronics*, vol 22, Aug 1979, p 687-691 9 refs Research supported by the U.S. Department of Energy

Measurements of the spectral collection efficiency and short circuit current decay rate following an X-ray pulse made on three types of single crystal silicon solar cells are represented. The cell types were  $n(+)-p$ ,  $p(+)-n$ , and  $p(+)-n-n(+)$  with base resistivities from 0.3 to 10 ohm-cm. Minority carrier lifetimes were determined using analytical or device code calculations, and for the  $n(+)-p$  and  $p(+)-n$  cells, nominal lifetimes of 2 and 5 microsec, respectively, were obtained. For the  $p(+)-n-n(+)$  device a lifetime greater than 100 microsec was inferred. The difference in base lifetime for the  $p(+)-n$  and  $p(+)-n-n(+)$  structures is attributed to gettering during phosphorus diffusion to form the back surface field layer. A T

**A79-52325 \*** The potential of np GaAs solar cells for high efficiency concentrator applications. A Flat and A G Milnes (Carnegie-Mellon University, Pittsburgh, Pa.) *Solid-State Electronics*, vol 22, Aug 1979, p 745-749 8 refs Grant No NGR-39-087-021

This communication considers the design of the front grid contact of np GaAs solar cells for high efficiency concentrator applications. This design involves shadowing, contact resistance, and active layer sheet resistance losses, and at high concentrations, the power loss due to voltage drop on the resistance of the grid fingers should be considered. Analysis of the performance can be calculated as a function of junction depth and surface recombination velocity. The junction depth can be optimized by considering its effect on the collection efficiency of the dark current-voltage characteristics or the open circuit voltage, and on the series resistance loss or the fill factor for material parameters. The choice of the material parameters, calculation of the short circuit current, the selection of the  $n$  layer thickness, and the cell maximum power and efficiency are discussed. It is concluded that optimized multi-grid structures should allow the use of 10 by 10 sq cm cells with good efficiencies at high concentration ratios, and efficiencies of 22 to 25% should be obtainable from large area cells at concentrations of 40 AM1. A T

**A79-52352** On the effects of pellet neutron moderation on the blanket neutronics of inertially-confined fusion reactors T D Beynon and R Bryant (Birmingham University, Birmingham, England) *Journal of Physics D - Applied Physics*, vol 12, Sept 14, 1979, p 1453-1462 13 refs Research supported by the Science Research Council

A computational study is made of the effects on various blanket parameters of the neutron moderation produced in the highly compressed deuterium tritium pellet of an inertially confined thermonuclear reactor based on the Wisconsin SOLASE design. For a pellet in a compressed state of a density radius product of 1.2 g/sq cm, studies are made of the blanket neutron heating, gas production and tritium production. Compared with a monoenergetic 14.1 MeV neutron source, the values of these parameters can change by as much as 15%. (Author)



**A79-52368** Analysis of the thermal state of a radioisotopic thermoelectric generator under conditions simulating a fire E P Oganov, Iu F Kozlov, and T P Zorina (*Teplofizika Vysokikh Temperatur*, vol 17, Jan-Feb 1979, p 146-151) *High Temperature*, vol 17, no 1, July 1979, p 123-127 8 refs Translation

The article gives the results of the mathematical modeling of the thermal state of radioisotope thermoelectric generators under emergency fire conditions, using a digital computer. It gives experimental data used to find the overall heat transfer coefficient to the generator with a fire from the solution of the inverse thermal conductivity problem. With application to a radioisotopic generator working on Sr-90, a numerical analysis is given of the nonstationary distribution of the temperature of its elements with the short-time thermal action of a fire, taking account of the internal heat evolution with isotopic decomposition and of thermoelectric effects in the converter.

(Author)

**A79-52369** Inhomogeneity of the transverse current in an MHD channel and its effect on the local characteristics of an MHD generator V V Kirillov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 17, Jan-Feb 1979, p 152-162) *High Temperature*, vol 17, no 1, July 1979, p 128-137 12 refs Translation

The effect on the characteristics of an MHD generator of an inhomogeneity in the transverse current produced by its flowing from the plasma stream to the horizontal walls of the MHD channel is considered. An approximate method for the solution of the three-dimensional problem of the electrodynamics of an MHD channel with allowance for this effect is proposed which provides a technique to calculate the local electrical characteristics of an MHD generator with allowance for inhomogeneities in the velocity and conductivity at the electrode and insulated walls, the surface conductivity of the walls, and the cathode drop of the potential. The calculated characteristics of the MHD generator are compared to the experimental data, and the effect of the surface conductivity of the channel walls on the MHD generator is analyzed in the presence of a substantial inhomogeneity in the plasma conductivity in the boundary layers at the channel walls.

A T

**A79-52371** Investigation of velocity profiles in an MHD generator channel using combustion products. N I Mazur and M M Nekhamin (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR) (*Teplofizika Vysokikh Temperatur*, vol 17, Jan-Feb 1979, p 173-178) *High Temperature*, vol 17, no 1, July 1979, p 145-149 8 refs Translation

The velocity profiles in the channel of an MHD generator for various electrical conditions and parameters of the working substance is investigated, measured using cooled Pitot tubes. The increase in the fullness of the profile on an insulated wall, due to the action of the magnetic field is discussed. The profile shape and the variation in the boundary layer characteristics along the channel are compared with theory.

(Author)

**A79-52372** Distribution of electric fields and currents in an MHD channel with a loop design in the region of a magnetic field jump. V A Krut'lin and A P Rashchepkin (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR) (*Teplofizika Vysokikh Temperatur*, vol 17, Jan-Feb 1979, p 179-184) *High Temperature*, vol 17, no 1, July 1979, p. 150-154. 6 refs Translation

An attempt is made to describe, within the small magnetic Reynolds number approximation, the structure of the electrical eddy currents at a magnetic field inhomogeneity in a looped MHD channel of constant loop pitch, under the assumption of a constant plasma flow rate. The approximate solution is used to analyze the influence of a magnetic field inhomogeneity in the end region of a looped MHD channel with series connected segmented electrodes on the performance of the MHD generator.

V P.

**A79-52381** Nonlinear effects in propagation of lower hybrid waves in a plasma. A G Litvak, A M Sergeev, and N A Shakhova (Akademiia Nauk SSSR, Institut Prikladnoi Fiziki, Gorki, USSR) (*Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol 5, Jan 26, 1979, p 86-90) *Soviet Technical Physics Letters*, vol 5, Jan 1979, p 33-35 7 refs Translation

Nonlinear effects in three-dimensional quasi-optical electromagnetic beams in a homogeneous plasma are analyzed for the case where the wave frequency is near the lower hybrid frequency. The aberration-free approximation is used to determine the characteristics of nonlinear defocusing. Self-focusing of lower hybrid waves is shown to be fundamentally different from that of waves in an isotropic plasma, with the most important difference being that three-dimensional beams do not collapse.

F G M

**A79-52536** Calorimetric emissivities for solar-selective coatings on flat sheet. G B Smith and H Willrath (New South Wales Institute of Technology, Broadway, Australia) *Journal of Physics E - Scientific Instruments*, vol 12, Sept 1979, p 813, 814 6 refs. Research supported by the Australian Research Grants Committee.

A calorimeter designed for measuring the hemispherical emissivity of flat sheet, coated on one side only, is described. Prime interest is in solar-selective coatings. A novel technique is used to ensure negligible heat losses from all but the coated surface. Results indicate that for selective coatings hemispherical emissivity is always significantly larger than normal emissivity, as found from spectral reflectance.

(Author)

**A79-52537** Vacuum ultraviolet spectroscopic apparatus for space- and time-resolved measurements on a single tokamak plasma discharge. C Breton, C De Michelis, M Finkenthal, and M Mattioli (EURATOM and Commissariat à l'Energie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France) *Journal of Physics E - Scientific Instruments*, vol 12, Sept 1979, p 894-898 7 refs.

**A79-52538** Operation of self-excited generators for wind-mill application. H R Bolton and V C Nicodemou (Imperial College of Science and Technology, London, England) *Institution of Electrical Engineers, Proceedings*, vol 126, Sept 1979, p 815-820 15 refs. Research supported by the Science Research Council of England.

The paper deals with the operation of self-controlled wound-field generators for small-scale wind-power application in which the output is connected to a constant resistance load and the field is connected in plain shunt or series. It is shown that, with this configuration, a fairly good natural match can be obtained between the power/speed characteristics of the generator and the windmill, particularly when the magnetic circuit of the generator goes fairly hard into saturation at higher speeds and field currents. Test results are included and indicate that an external d.c. source would often be necessary to initiate 'build-up' in a practical system.

(Author)

**A79-52570** Resource recovery and recycling. A F M Barton (Murdoch University, Murdoch, Australia) New York, Wiley-Interscience, 1979, 430 p 1232 refs \$25 95

The scientific and technological bases and criteria for resources recycling and energy recovery are reviewed. Attention is given to economic, physical, environmental, technological, energy and social factors influencing the feasibility of recycling materials at various levels and for various secondary uses. Physical methods of separation and recovery, including mechanical, electrical, magnetic, and thermal processes, are discussed and chemical and microbiological means of separation and waste conversion are considered. Postconsumer waste is examined and its treatment is discussed, and recycling processes for industrial and agricultural wastes are presented. Consideration is also given to the thermodynamics of recycling and to recycling by elements, and extensive references permitting access to technical material in the fields of chemistry, chemical engineering, physics and microbiology are compiled.

A L W

**A79-52572** **Cost study of superheating geothermal steam**  
J M Hensler, III and R C Axtmann (Princeton University, Princeton, N.J.) *Energy* (UK), vol 4, June 1979, p 365-371 18 refs

This study compares the electrical generating costs for hybrid plans, in which fossil fuel superheats geothermal steam, with those for conventional dual-flash plants. Parameters varied in the analysis include the resource temperature and the geothermal gradient. In order to make the results generally useful, we have made conservative estimates of site-dependent variables. The results indicate that superheating can significantly improve the economic competitiveness of geothermal resources that would normally be considered uneconomical. In addition, superheat will increase total plant outputs markedly and enhance thermal efficiencies by 30-40% (Author)

**A79-52573** **Reducing institutional barriers to solar energy through the use of cooperatively-owned solar energy systems** M B Packer (MIT, Cambridge, Mass.) *Energy* (U.K.), vol 4, June 1979, p 383-392 51 refs

Despite the conceptual attractiveness of solar energy systems for space-heating applications, the market penetration rate of solar systems remains low. The physical, economic, and institutional barriers to acceptance that cause this disappointing performance are closely related to the present political, social, and economic structure, and so are proving difficult and time consuming to lower. However, aggregating small solar systems into larger cooperative ventures can avoid many of these barriers altogether. This 'product-fit' approach could greatly increase the diffusion rate of solar energy systems into the economy, thereby replacing fossil-fuel uses sooner and to a greater extent than previously expected (Author)

**A79-52574** **An assessment of thermal energy storage in conjunction with heat pumps for residential heating and cooling** M B Packer and L R Glucksman (MIT, Cambridge, Mass.) *Energy* (U.K.), vol 4, June 1979, p 393-399. Research supported by the Massachusetts Institute of Technology

**A79-52575** **Hydroelectric power generation and mineral recovery in the Qattara Depression of Egypt** J J Murray (US Army, Research Office, Research Triangle Park, N.C.) *Energy* (UK), vol 4, June 1979, p 463-468 21 refs.

The Qattara Depression is a naturally formed geological sink hole located in the north central part of Egypt. It covers an expanse of over 19,400 sq km of desert surface and has an average depth of 60.9 m below sea level. Its closest point of access to the Mediterranean Sea is about 64.4 km near El Alamein. From the standpoint of electrical power generation, the Qattara is relatively close to the two principal cities of Egypt: 225 km to Cairo (the capital) and 177 km to Alexandria. Development of tremendous hydroelectric power can be achieved by diverting the Mediterranean Sea water through the intervening region of forty miles (at the Alamein sector) by means of a combination canal/tunnel or channel to the Qattara side of the 182.9-m escarpment. Hydroelectric power generation and mineral extraction from the Mediterranean Sea water are discussed. First-order estimates are presented. S D

**A79-52644** **High power iodine atom laser** K Hohla (Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Garching, West Germany). In: High power laser and applications, Proceedings of the Fourth Colloquium on Electronic Transition Lasers, Munich, West Germany, June 20-22, 1977. Berlin and New York, Springer-Verlag, 1978, p 124-141 29 refs

A high-power atomic iodine laser for fusion applications is described in detail, with emphasis on future prospects and development possibilities. The lasing mechanism is reviewed, the generation of high-power laser pulses is considered, and short pulse generation is examined. Pulse propagation in an amplifier chain is discussed, along with the scalability and efficiency of a multikilojoule-pulse-energy laser, the ASTERIX III end amplifier, and effects that degrade the

efficiency of the iodine laser. The main advantages of the iodine laser as compared with the Nd-glass laser are shown to be a higher repetition rate and a higher self-focusing power level. F G M

**A79-52667** **Proposed non-interferometric FIR electron density measuring scheme for tokamaks** G Dodel and W Kunz (Stuttgart, Universität, Stuttgart, West Germany). (Swiss National Science Foundation, Eidgenössisches Militärdépartement, and Eidgenössische Technische Hochschule Zurich, International Conference on Infrared Physics, 2nd, Zurich, Switzerland, Mar 5-9, 1979) *Infrared Physics*, vol 19, Aug 1979, p 443-446 9 refs

Extension of FIR polarimetry to electron density measurements in tokamaks is suggested as a possible alternative for devices in which FIR interferometry is not applicable or difficult to handle due to reduced accessibility or strong mechanical vibrations. The method is numerically simulated. The relative experimental simplicity compared with interferometry has to be paid for with symmetry assumptions which enter into the evaluation process (Author)

**A79-52798** **Non-uniform power distribution in linear induction motors due to end effects** R J A Bevan and G Kalman (Air Research Manufacturing Company of California, Torrance, Calif.) (Institute of Electrical and Electronics Engineers, Summer Meeting, Los Angeles, Calif., July 16-21, 1978) *IEEE Transactions on Power Apparatus and Systems*, vol PAS 98, Sept-Oct 1979, p 1516-1520. Discussion, p 1521 19 refs. Research supported by the US Department of Transportation

This paper presents experimental data showing the effects of electrical and magnetic discontinuities on linear induction motor (LIM) performance. The power distribution along the LIM, the effect of the machine length, and the validity of assuming a LIM model in which the iron extends beyond the bound of the winding were investigated (Author)

**A79-52799** **Major electrical equipment proposed for tidal power plants in the Bay of Fundy** R M Seoni (Acres Consulting Services, Ltd., Niagara Falls, Canada). (Institute of Electrical and Electronics Engineers, Summer Meeting, Mexico City, Mexico, July 17-22, 1977) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-98, Sept-Oct 1979, p 1750-1758. Discussion, p 1759, 1760 12 refs

The paper discusses general considerations and future possibilities for the design of generating equipment for tidal power plants with particular reference to Bay of Fundy sites. Factors affecting the design of turbines, generators, excitation system, powerhouse layout and the main electrical connections are reviewed. Various alternatives for transmission of power to shore are listed and the choice of SF6 gas insulated bus duct is substantiated by comparative data. Advantages of integrating the high-voltage switching station with the powerhouse, using SF6 gas insulated metal clad switchgear are discussed. The paper concludes that advances in technology can make a significant contribution to economic development of tidal power (Author)

**A79-52800** **Development of a DC linear motor** II T Umemori (Japanese National Railways, Railway Research Institute, Kokubunji, Tokyo, Japan), Y Hosoda (Sumitomo Electric Industries, Ltd., Osaka, Japan), M Iwasaki (Furukawa Electric Co., Ltd., Tokyo, Japan), and M Toyoshima (Hitachi Cable Ltd., Hitachi, Ibaraki, Japan). (Institute of Electrical and Electronics Engineers, Summer Meeting, Los Angeles, Calif., July 16-21, 1978) *IEEE Transactions on Power Apparatus and Systems*, vol PAS 98, Sept-Oct 1979, p 1786-1794. Discussion, p 1795

We have constructed a test facility for the linear motor car mainly to examine its propulsion characteristics. The 3.3 ton vehicle has a 2 ton propulsion force and can be accelerated to 165 Km/h in 200 m. In this paper, our investigation of the field-magnet and armature coils on the ground is reported. We discuss the correspon-

dence of our theoretical analysis with the results of experiments. We believe that the results of our investigation can be readily applied to an actual DCLM line (Author)

**A79-52951** Limits to wind-power R W B Best (EURATOM and Stichting voor Fundamenteel Onderzoek der Materie, Instituut voor Plasmafysica, Jutphaas, Netherlands) *Energy Conversion*, vol 19, no 2, 1979, p 71, 72. Research supported by the Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek and EURATOM

Simple formulas are given for the change in wind-power, frictional stress and vertical energy transport in the atmospheric boundary layer, caused by the erection of windmill arrays. The limit to wind-power conversion appears to be around 1 W/sq m of terrain in both coastal and inland areas (Author)

**A79-52952** Model of photofuel element on the base of chlorophyll sensitized reactions E Iu Kats, Iu N Kozlov, and B A Kiselev (Academy of Sciences, Institute of Photosynthesis, Pushchino, USSR) *Energy Conversion*, vol 19, no 2, 1979, p 73-75. 10 refs

Photogalvanic effect has been studied in ethanol aqueous solution containing  $1 \times 10$  to the -3rd M cysteine,  $5 \times 10$  to the -5th M chlorophyll 'A' and  $1 \times 10$  to the -4th M methylviologen. During photosensitized reduction of methylviologen open-circuit photovoltage was -650 mV and short-circuit photocurrent was 100 microamperes/sq cm. The maximum power output from the photogalvanic element was  $2 \times 10$  to the -5th W at load resistance 6 kilo ohms. Principal differences and advantages of investigated triple photochemical system have been discussed as compared with double photochemical systems consisting of pigment and electron donor. Since the power output from the element consists of absorbed light power and power of electron donor oxidation, such electricity source may be called 'photofuel element'. The possibility of application of the investigated photochemical system for creation of high efficiency photoelectroconverters of solar energy has been suggested (Author)

**A79-52953** Electrical induction heating - A new approach to underground coal gasification S T Fisher (F T Fisher's Sons, Ltd, Montreal, Canada) *Energy Conversion*, vol 19, no 2, 1979, p 77-84. 7 refs

Two methods are proposed to replace underground coal gasification processes. The first involves underground distillation of coal by induction heating, and the second, underground gasification of char by combustion. It is noted that coal has a high eddy-current loss, and thus absorbs energy efficiently from an intense magnetic field. It is shown how this principle can be used to distill high-heat-value gas and tar from a coal deposit, while the residual char may be gasified by combustion heating. The overall process shows significant advantages over present methods of underground coal gasification by combustion. Finally, available physical and chemical data and laboratory investigations indicate the technical and economic feasibility of the process. M E P

**A79-52954** Evacuated heat pipe solar collector F Mahdjuri (Philco Italiana S.p.A., Brembate Sopra, Italy) *Energy Conversion*, vol 19, no 2, 1979, p 85-90. 6 refs

A tubular evacuated solar collector with rectangular collector performance characteristics is described. It is reported that the heat transfer from the absorber plate (which has selective coating) to the water tubing occurs via a heat pipe system. A trap mechanism is included for the condensed liquid in order to prevent any delay in the operation of the heat pipe due to superheating of the vapor. To avoid the disadvantage of the high no load condition of the vacuum collectors, consideration is given to the physical features of the critical point of the heat pipe working fluid. Finally, for the heat pipe system discussed, working liquids with the critical temperature between 95-115 C have been chosen. M E P

**A79-52955** Improvement of characteristics of nonequilibrium MHD generator by applying current parallel to magnetic field D Tanaka and Y Hattori (Kyoto University, Uji, Japan) *Energy Conversion*, vol 19, no 2, 1979, p 91-99. 12 refs

Quasi three-dimensional analysis is made to estimate effects of applied current parallel to magnetic field on the characteristics of nonequilibrium Faraday MHD generator. Potassium-seeded argon plasma at 1500 K and 10 atm is assumed. Resistive power extraction electrode is taken into account to reduce the current concentration phenomena occurring at electrode edges. The applied current parallel to magnetic field enlarges the stable region free from ionization instability. The net output power exceeds the power obtained for the case of no applied current in the limited ranges of applied current and Hall parameter. The resistive power extraction electrode is useful to successfully prevent the applied current from short-circuiting along the electrode surface (Author)

**A79-52956** Critique on the solar rehabilitation procedures used in SOLMET-2 D Rapp (Texas, University, Richardson, Tex.) *Energy Conversion*, vol 19, no 2, 1979, p 101-110. 7 refs

A critique of the NOAA procedure for rehabilitation of solar data is given by comparing recent data on clear solar noon atmospheric transmission with the calculated transmissions used in the rehabilitation process. It is found that the standard year irradiance (SYI) method used by NOAA is generally within about 3% of the data except for sites at high latitude in winter. The SYI values are too low at such sites, the worst case being Seattle where winter insolation is underestimated by over 20%. The overall assessment of the NOAA rehabilitation procedures at most sites is that the final result standard year corrected data provide a reasonable set of consistent values. However, the data at northerly sites are too low (Author)

**A79-52957** The role of interfacial heat and mechanical energy transfers in a liquid-metal MHD generator G Fabris and E S Pierson (Argonne National Laboratory, Argonne, Ill.) *Energy Conversion*, vol 19, no 2, 1979, p 111-118. 5 refs. Research sponsored by the U.S. Department of Energy and U.S. Navy

A brief description of the two-phase liquid metal MHD power generation cycle and its advantages is provided. The importance of good interfacial liquid to gas heat transfer is discussed, and data confirming that satisfactory heat transfer is indeed achieved in an experimental generator is presented. An expression for the effect of the velocity difference between the gas and the liquid on generator performance is derived. An 'equivalent turbine' efficiency is defined to characterize the generator as part of a heat engine and related to experimental data (Author)

**A79-52958** Power output of an MHD generator - Effect of ionization instability and boundary layer M S Sodha and B K Gupta (Indian Institute of Technology, New Delhi, India) *Energy Conversion*, vol 19, no 2, 1979, p 119-124. 12 refs. NSF supported research

This paper presents an investigation of the effect of ionization instability on effective conductivity and power output of an MHD generator in the presence of velocity/temperature boundary layer. Analysis is based on a phenomenological approach. It is concluded that the ratio of power output (in the presence of ionization instability) to the power output (without ionization instability) increases with an increase in the boundary layer thickness. Effective conductivity and power output both are found to decrease with the increasing magnetic field (Author)

**A79-52960** Transport properties of Nafion membranes in electrochemically regenerative hydrogen/halogen cells R S Yeo and J McBreen (Brookhaven National Laboratory, Upton, N.Y.) (*Electrochemical Society, Meeting, Seattle, Wash., May 21-26, 1978*) *Electrochemical Society, Journal*, vol 126, Oct 1979, p 1682-1687. 38 refs. Research sponsored by the U.S. Department of Energy

An investigation has been carried out on the transport properties of Nafion membranes as related to electrochemically regenerative hydrogen/halogen energy storage systems. Included are a determination of membrane conductivity as a function of HCl concentration and temperature and determination of hydrogen, chlorine, and bromine permeation rates and diffusivities in various HCl and HBr environments at various temperatures. Transport properties of the membrane are related to the water content of the membrane. In the case of bromine, negatively charged complex formation results in lower permeation rates than expected. Results indicate that hydrogen/chlorine cells should have voltaic efficiencies in excess of 75% at current densities of about 300 mA/sq cm and coulombic losses in the vicinity of 2% (Author)

**A79-52967** The synfuels scenario. *Environmental Science and Technology*, vol 13, Oct 1979, p 1190-1196 5 refs

Plans for reaching the Administration's goal to produce 2.5 million barrels of synthetic fuel daily by 1980 are studied. Conversion of coal to liquid is discussed, emphasizing five processes still awaiting commercialization, including Dynalectron, Exxon, Gulf, and South African State Oil (SASOL). Fundamental considerations that are inherent in a synfuel plant are analyzed and the DOE developed INTACT (Integrated Approach to Environmental Control for Coal Liquefaction Plants) program are considered. Attention is given to present liquefaction projects such as those employing ZnCl<sub>2</sub> hydrocracking processes. Gasification and shoal projects that could yield 100 to 300,000 barrels of oil per day are also among the topics which were examined. C F W

**A79-52968** MHD emissions and their controls. P Matray and G Huddleston (Montana Energy and MHD Research and Development Institute, Inc., Butte, Mont.) *Environmental Science and Technology*, vol 13, Oct 1979, p 1208-1213 6 refs. Contracts No EP-78-C-02-4651, No EF-77-C-01 2430

The use of magnetohydrodynamics (MHD) as a new energy technology due to its efficiency and cost-effectiveness is examined. Three major goals of the DOE are discussed, which include (1) achieving overall coal-to-busbar efficiencies near 50% in MHD demonstration facilities, (2) demonstrating the economic feasibility of MHD, and (3) meeting environmental emission standards for sulfur dioxide, nitrogen oxides, and particulates. Attention is given to MHD generated wastes such as seed, fly ash, and slag, and those generated by conventional coal-fired power plants. The three major EPA regulations which affect air quality, such as NSPS, PSD, and the National Ambient Air Quality Standards (NAAQS) are discussed and their bearing on the development of MHD is noted. C F W

**A79-53209 #** Possibility of solving the controlled nuclear thermonuclear synthesis problem on the basis of magnetogasdynamic cumulative energy (O vozmozhnosti resheniya problemy upravlyаемого termoiadernogo sinteza na osnove magnitogazodinamicheskoi kumulatsii energii). V N Mokhov, V K. Chernyshev, V B Iakubov, M S Protasov, V. M. Danov, and E I Zharinov. *Akademiia Nauk SSSR, Doklady*, vol 247, no 1, 1979, p 83-86 14 refs. In Russian

Extensive studies have been made of the compression of spherical targets by means of intense laser beams. In the present paper the effectiveness of an approach to controlled thermonuclear synthesis, based on the compression of thermonuclear targets by a magnetic field is demonstrated theoretically and experimentally. V P

**A79-53261** Solar thermal aerostat research station /STARS/. E C Okress and R K Soberman (Franklin Institute, Franklin Research Center, Philadelphia, Pa.) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-35* 12 p 14 refs

The paper introduces the concept of a large, constant volume, solar powered, warm air, spherical rigid navigable aerostat able to remain aloft in the stratosphere for many years. Equipped with

compressed stratospheric air for energy storage, it will be capable of performing, on a 24-hour basis, a wide variety of missions, including surveillance, solar energy generation and radiation or particle beam transmission to the surface, environmental monitoring, local weather modifications, long-range communications and microwave power relay, nighttime target illumination, weapons platform of high energy requirements, platform for aircraft launch and recovery, platform for space hardware and reusable spacecraft catapult launching, etc. Most, if not all, of these numerous missions may be conducted simultaneously, due to the unprecedented lift capability of the proposed stratoscraft. With solar energized compressed air and electric thrusters, it will be capable of 24 hours navigation and hovering in the stratosphere in most regions about the earth, and throughout the year, for many (e.g., about 10) years (Author)

**A79-53301** Superlight rotating reflectors in space. A V Luk'ianov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-112* 14 p 10 refs

The use of large mirror reflectors in space to control solar and electromagnetic radiation with specific mass of order of 1 gm/sq m or less is examined. Such reflectors may be used in space energetics for concentration of solar energy for its conversion into a microwave beam and transmission to earth, for illuminating the earth surface with reflected sunlight, weather control, and research. Design and construction of the reflector, its main parameters including angular and rotative speed, and the control of rotation, precession, and nutation, and the position control in space are discussed. The control of its orientation and space position is performed with solar energy and light pressure, and the film strength permits concentrators with a radius of several kilometers and nearly flat reflectors for lighting application with a radius of several hundred meters. More than a hundred reflectors of 600 m diameter can be assembled at a station at the 1000 km height yearly, but a difficult problem of superthin film mass production and assembly technology problems must be solved to realize this program. A T

**A79-53302 \*** Cost comparisons for the use of nonterrestrial materials in space manufacturing of large structures. E H Bock and R C Risley (General Dynamics Corp., Convair Div., San Diego, Calif.) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-115* 24 p 16 refs. NASA-sponsored research

This paper presents results of a study sponsored by NASA to evaluate the relative merits of constructing solar power satellites (SPS) using resources obtained from the earth and from the moon. Three representative lunar resources utilization (LRU) concepts are developed and compared with a previously defined earth baseline concept. Economic assessment of the alternatives includes cost determination, economic threshold sensitivity to manufacturing cost variations, cost uncertainties, program funding schedule, and present value of costs. Results indicate that LRU for space construction is competitive with the earth baseline approach for a program requiring 100,000 metric tons per year of completed satellites. LRU can reduce earth launched cargo requirements to less than 10% of that needed to build satellites exclusively from earth materials. LRU is potentially more cost-effective than earth-derived material utilization, due to significant reductions in both transportation and manufacturing costs. Because of uncertainties, cost-effectiveness cannot be ascertained with great confidence. The probability of LRU attaining a lower total program cost within the 30-year program appears to range from 57 to 93% (Author)

**A79-53330** Satellite power systems /SPS/ and semiconductor photovoltaic cells /SPC/. M Subotowicz (Lublin, Uniwersytet, Lublin, Poland) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-166* 15 p 16 refs

This paper considers semiconductor photovoltaic cells and efficiency of solar energy conversion. The material constants of efficient solar cells and selection of photovoltaic materials for homo-, hetero-, and Schottky barrier diodes to optimize pair generation and the space separation of the electrons and holes are discussed. The silicon materials for solar cells including single crystal, polycrystalline p-n junction, amorphous silicon, and silicon films are described, noting that the advantages of the II-VI compounds are low price, direct energy gap, and the ability to produce thin film solar cells of up to 12% efficiency. The III-V compounds, such as GaAs/Ga(1-x)Al(x)As, have the highest efficiency of up to 25%, and the two-component compounds such as GaSe, InSe, Cu<sub>2</sub>O, and SnS provide easy synthesis and crystal growth, chemical stability, low cost, and easy doping. A T

**A79-53333 Optimisation of powerful energy supply systems for application in space.** J. Blumenberg (München, Technische Universität, München, West Germany). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-169* 22 p 7 refs

Energy supply systems for application in space are, as a rule, optimized in terms of their specific mass (kg/kWe) or their specific power (kWe/kg). An optimization criterion for space power systems is defined. Nuclear power systems with turbogenerator are discussed relative to optimization of a system with Carnot-cycle, and optimization of systems with real engine cycles. Attention is given to nuclear power systems with MHD generator, and to nuclear power systems with thermionic converters. The optimum specific masses of the system types discussed for a realistic hot-side temperature and different net electric powers are listed. S D

**A79-53334 Solar power satellites for Europe.** J. Ruth and W. Westphal (Berlin, Technische Universität, Berlin, West Germany). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-173* 12 p 6 refs

The potential utilization of Solar Power Satellites (SPS) as baseload powerplants for Western European countries is studied. Attention is given to significant differences with the USA in factors such as geographical, political, organizational, orbital, and industrial. Among the problems discussed which must be solved prior to full scale SPS development is the impact on the environment. Finally recommendations are made and conclude that the analysis of specific European problems has to be extended and refined, a joint group of US and European planners and engineers must work out the specifications for a cooperation in a technology program after 1982, and a specific European experimental program on the impacts of SPS installation and operation on the environment has to be implemented. M E P

**A79-53335 European technology applicable to Solar Power Satellite Systems (SPS).** H. Stoewer (ESA, System Engineering Dept., Noordwijk, Netherlands), B. Tilgner (ESA, Technology, Industry and Infrastructure Dept., Paris, France), and D. Kassing (ESA, Spacecraft Power Supplies Div., Noordwijk, Netherlands). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-174* 23 p 14 refs

The paper reviews European space technology activities that have potential for application in an SPS program. Existing and developing European space technologies are compared with the expected requirements of a study assessment and early key technology verification investigation for the SPS concept. It is shown that a number of existing European space technologies and the results of current development efforts apply well to this. Topics discussed include solar energy conversion, electrical energy conversion, electrical to microwave conversion, microwave power transmission, space structures, attitude and orbit control, thermal control, and ground receiver stations. M E P

**A79-53336 Satellite solar power station designs with concentrators and radiating control.** A. V. Luk'ianov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-176* 6 p 6 refs

The paper investigates the application of superlight rotating parabolic concentrators for space energetics. The total mass of all high temperature converters considered, does not exceed that of the transmitting antenna. Attention is given to a design with two concentrators weighing 30 Mg, which offers the possibility of control of mast orientation by using thin movable mirrors of tungsten or other thermoresistant material in the concentrator focus. In this manner reflection of an insignificant part of concentrated energy in the corresponding direction will create the necessary thrust. Also discussed are a satellite power station (SSPS) with numerous concentrators and SSPS with solar cells. Here eight adjustable mirrors situated along the periphery could work as concentrators as well as corrections engines. M E P

**A79-53337 A space power station without movable parts.** M. Pospisil (Ceskoslovenska Akademie Ved, Astronomicky Ustav, Ondrejov, Czechoslovakia). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-177* 10 p

An area of suitable shape could be used as a receiver of solar radiation ('outer' surface) and a microwave antenna ('inner' surface). Elimination of the necessity to revolve the panels with cells, delivery of power according to the average demand and other features of this SPS concept are discussed. (Author)

**A79-53353 Thin film solar collectors for material science experiments in space.** B. Authier, L. Hill, and C. Fayard (CNRS, Laboratoire d'Astronomie Spatiale, Marseille, France). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-202* 10 p 9 refs. Research supported by the European Space Agency

The optical feasibility of thin film solar concentrators suitable for space material science is investigated through an optical simulation of the ray-tracing type and measurements on inflated balloons of polyester film. Simulation in a meridian plane is chosen since only circular collector optics is suitable. An analytical method might be considered, but a ray trace method is more convenient to take account of the different parameters that may influence ray dispersion. Optical simulation is discussed relative to representation of the solar disk and simulation of the scattered light from the collector. Attention is given to inflatable mirror performance. Plastic film concentrating mirrors have the potential of a very lightweight mirror at low cost per unit area. The cross section of an inflated 'ellipsoidal' membrane mirror is schematically presented. The inner surface of the lower membrane is aluminized (or silvered) to form the mirror, and the upper surface is transparent. The curvature of the mirror is obtained by inflating the space between the surfaces. Also discussed are space environment requirements. S D

**A79-53356 Space to benefit mankind - 1980 to 2000.** C. L. Gould (Rockwell International Corp., Satellite Systems Div., Downey, Calif). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-206* 22 p 13 refs

This paper deals with the use of space for major, tangible benefits with commercial and social value over the next three decades. A background of future needs and trends is presented, and opportunities for applying space to these needs are listed. An overall suggested space industrialization program is presented, and the benefits of such a program are shown. (Author)

**A79-53357 \* Orbital demonstration - The prelude to large operational structures in space.** T. Hagler (NASA, Office of Advanced Programs, Washington, D.C.). *International Astronautical*

*Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-207. 16 p Contracts No. NAS9-15310, No NAS8-32394, No. NAS9-14916*

The paper surveys three specific large space structures which have been analyzed to determine the technology needed to achieve a fully operational system. These are the multipurpose platforms, satellite power systems, and a deployable antenna. Further attention is also given to those technology needs which can be satisfied by ground based technology (simulation), such as payload carrier modification or design, platform element connectors and fittings, data compression and storage equipment, man-machine interface and productivity assessment, and astronaut aids. Also covered are those technology and performance parameters which require demonstration in orbit. M.E.P.

**A79-53418** Structuring the international marketplace for maximum socio-economic benefits from space industrialization. W A Good (Earth Space Transport Systems Corp., New York, N.Y.), G S Robinson (Smithsonian Institution, Washington, D.C.), M F Shkun (New York University, New York, N.Y.), and E F Sudit (Rutgers University, New Brunswick, N.J.) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-A-14 14 p 86 refs*

The methodology of situational normativism is used to suggest an effective international framework for commercial expansion into outer space, including the necessary resolution of any conflict which may arise. The possible integration of air and space commerce is examined. New commercial space technologies are evaluated in terms of their economic characteristics. Space industrialization is viewed as the process of developing space transport markets. Private common carriers are given the rights and responsibilities for developing various categories of commercial space applications based on economic and technological considerations. The role of government is seen restricted to research and development for the purpose of increasing the technology base, regulation of safety and economic activities, participation in the provision of pure public goods, and provision of supporting services. V T

**A79-53419** A socio-economic evaluation of the lunar environment and resources. II - Energy for the selenosphere. K A Ehrlicke (Space Global Co., La Jolla, Calif.) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-A-16 25 p 13 refs*

The paper presents an outlook on the energy consumption levels for inhabiting the selenosphere. Concepts for low propellant access to and from the lunar surface are presented with calculations of hydrogen and oxygen use. Attention is given to transportation and its role in the development of lunar industrial complexes, as well as to a transportation cost analysis. Various transportation cost components, such as the use of lunar liquid oxygen and reusable chemical/nuclear IOV, are examined. The abundance of lunar elements that can be employed in industrial processes and operations is presented. Data is tabulated for converting energy sources into consumable output, and information is given on the production of nuclear power systems. C F W.

**A79-53432** A nuclear waste deposit in space - The ultimate solution for low-cost and safe disposal. H O Ruppe, D Hayn, M Brautinger, and R H Schmucker (Munich, Technische Universität, Munich, West Germany) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-A-15 34 p 11 refs. (TUM-LRT-7B-79/3)*

Transport of nuclear high active waste (HAW) into space is examined. With the Space Transportation System and high flight frequencies, proper casing of the HAW, and limitations to small amounts of waste per flight, economical disposal of HAW in space should be possible. Four mission concepts are evaluated: (1) the direct transfer to the sun with the waste destroyed there, (2)

transport outside the solar system, (3) establishment of a lunar waste deposit with maintenance by a manned lunar station, and (4) transport to a high earth orbit and storage within a large space structure. Alternatives for nuclear waste elimination including the earth bound solution such as dumping into sea or deposit in a salt mine, deposit on the moon's far side, safety considerations, and costs for earth-bound deposits and spaceflight operations are also discussed. It is concluded that waste disposal in space will provide safe disposal, option of future reprocessing, and economical use of space technology. A T

**A79-53452 #** Legal aspects of solar power satellites - Focus on microwave exposure standards. S Gorove (Mississippi University, University, Miss.) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-IISL-01 9 p 12 refs*

Crucial legal problems of solar power satellites center around geostationary orbit availability, microwave frequency allocations, and microwave exposure standards. One of the major concerns involving the transmission of microwave beams from geostationary satellites to selected places on earth relates to the all important question of what effect exposure to such transmission is going to have on humans and biota in the receiving area, on the ground and in the air space which the beams traverse. Attention is given to a discussion of the nature of the microwave beam, effects of microwave exposure on humans and biota, and international aspects. With respect to the biological effects of microwave exposure and possibly other effects on the environment, it appears that there can be no choice but to pursue the route leading to a general international acceptance in order to eliminate any possible charge of negligence, should some injury or damage arise because of inadequacy. Acceptance of the most stringent exposure standards must be stressed. S D

**A79-53453 #** Institutional issues in international solar energy utilization. W von Kries (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany) *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-IISL-02 14 p 14 refs*

The paper examines large scale international utilization of solar energy for production of electric power or fuel. The international features of the Solar Power Satellite Plants (SPS) and the Solar Thermal Electric Conversion Plants (STEC) are compared, noting that an SPS plant would be more international because of its installations in outer space, use of the internationally regulated frequency, and its high costs could require contributions from several countries. Reasons for internationalizing SPS and STEC plants including geographical, environmental, as well as the effect of microwave beams on organisms and the ionosphere, economic, and strategic are discussed, comparing the effects of SPS and STEC plants on these factors. The STS space and ground framework, and a European STEC partnership organization are described, noting that STEC strengths are a proven organizational pattern, industrial/geographical decentralization, and cartel exclusion, while SPS has weaknesses of organizational gigantism, geographical/industrial centralization, and supplier oligarchy, concluding that STEC will probably materialize, rather than SPS. A T

**A79-53482 #** Solar energy bank for mankind in contemporary international space law. C C Okolie *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 79-IISL-47 35 p 44 refs*

The paper summarizes public and U.S. Congressional considerations on solar energy use. The new solar power technology will require legal norms to regulate utilization of solar option control and ownership, harmful effects, and cost of R & D, which should provide a code of conduct through international law. The economic factors

in solar energy technology and creation of a Solar Energy Bank in the context of developing of alternative energy sources, and safe, clean environmental aspects are discussed. The U.S., U.S.S.R., European, and the European Space Agency (ESA) discussions on the solar bank international law are described, noting that the best way to develop R & D is to create an international agency to manage development of alternative energy sources. The Soviet Union's activities in solar energy research are reviewed, and, finally, it is recommended that the law on solar energy must be based on space and environmental laws and that a Solar Energy Bank must be created where all nations are encouraged to participate. A T

**A79-53487** A power transmission concept for a European SPS system. R. A. Henderson (British Aerospace, Dynamics Group, Bristol, England). *International Astronautical Federation, International Astronautical Congress, 30th, Munich, West Germany, Sept 17-22, 1979, Paper 14* p. 15 refs.

A hybrid SPS system is proposed in which solar power is collected in geosynchronous orbit and transmitted by a concentrated laser beam to a receiver mounted on a 2.6-km diam rigid balloon stationed at approximately 30-km altitude, power is converted to microwave energy and beamed to the ground to multiple rectennae which are significantly reduced from those of the direct microwave transmission to ground concept. Waste heat from the energy conversion process would provide power to maintain a stable balloon platform which could perform other functions related to earth observation and communications. (Author)

**A79-53490** Optimization of a fixed solar thermal collector. J. D. Garrison (San Diego State University, San Diego, Calif.). *Solar Energy*, vol. 23, no. 2, 1979, p. 93-102. 11 refs.

Criteria are presented for optimizing solar thermal energy collection. These criteria are then used in setting the design of a fixed solar thermal energy collector. This design is obtained by proceeding carefully through a series of optimization steps. While seeking near optimum performance, features have been retained which should lead to low cost. Initial optimization steps lead to an all glass vacuum collector tube whose side and lower walls are internally silvered to provide optimal Winston concentration on an interior glass tube coated with a selective absorber. Heat transfer calculations, performed for an array module of these collector tubes, produce values for the radiation, heat conduction and pumping losses and indicate operating conditions which minimize these losses. Near this minimum, heat conduction and pumping losses are small and can usually be neglected. Liquids provide much better heat transfer than gases. (Author)

**A79-53491 \*** Evaluation of models to predict insolation on tilted surfaces. T. M. Klucher (NASA, Lewis Research Center, Cleveland, Ohio). *Solar Energy*, vol. 23, no. 2, 1979, p. 111-114. 8 refs.

An empirical study was performed to evaluate the validity of various insolation models which employ either an isotropic or an anisotropic distribution approximation for sky light when predicting insolation on tilted surfaces. Data sets of measured hourly insolation values were obtained over a 6-month period using pyranometers which received diffuse and total solar radiation on a horizontal plane and total radiation on surfaces tilted toward the equator at 37 degrees and 60 degrees angles above the horizon. Data on the horizontal surfaces were used in the insolation models to predict insolation on the tilted surface, comparisons of measured vs calculated insolation on the tilted surface were examined to test the validity of the sky light approximations. It was found that the Liu-Jordan isotropic distribution model provides a good fit to empirical data under overcast skies but underestimates the amount of solar radiation incident on tilted surfaces under clear and partly cloudy conditions. (Author)

**A79-53492** Prediction of the performance of solar heating systems over a range of storage capacities. P. J. Lunde (Center for the Environment and Man, Inc., Hartford, Conn.). *Solar Energy*, vol. 23, no. 2, 1979, p. 115-121. 9 refs.

A new method for prediction of the performance of solar heating systems using well-mixed storage is presented which predicts monthly and annual system performance (relative to a computer simulation) over a wide range of system variables including minimum or base storage temperature, storage capacity, and geographic location. The method relies on heavily preprocessed site specific radiation and weather data which is used with system properties to predict the quantities necessary for correlation. The method yields long-term monthly and annual performance predictions which are so accurate that they can serve simultaneously for preliminary design, economic optimization, and final design, eliminating the need for simulation. (Author)

**A79-53493 #** Passive solar heating of buildings using a transwall structure. R. Fuchs (U.S. Department of Energy, Ames, Iowa) and J. F. McClelland (Iowa State University of Science and Technology, Ames, Iowa). *Solar Energy*, vol. 23, no. 2, 1979, p. 123-128. 9 refs. Contract No. W 7405 eng 82.

A passive solar heating system is proposed employing a 'transwall', which is a partially transparent thermal storage wall placed adjacent to a window admitting solar energy. It is reported that part of the solar energy is absorbed within the transwall, and the remaining part is transmitted to the interior of the room. Calculations using thermal network models and based on reasonable assumptions for relative comparisons are used to compare the performance of transwall, Trombe wall, and direct gain systems. The analysis shows that the transwall system can be expected to have a thermal performance close to exceeding that of the other systems, depending on how effectively convective heat transfer is quenched in the thermal storage medium. Finally, the architectural attractiveness of the transwall is cited. M E P

**A79-53494** On the design and operation of electrochemical solar cells. S. Kar (Indian Institute of Technology, Kanpur, India), K. Rajeshwar, P. Singh, and J. DuBow (Colorado State University, Fort Collins, Colo.). *Solar Energy*, vol. 23, no. 2, 1979, p. 129-139. 64 refs. Research supported by the Colorado Energy Research Institute.

The theoretical principals underlying the design and operation of electrochemical solar cells are reviewed. These devices are discussed in terms of a modified Metal-Insulator-Semiconductor (MIS) model in which the interfacial layer in MIS solar cells is replaced by the electrolyte. Electrostatic aspects of electrochemical solar cells are analyzed with the help of energy band diagrams and compared with those for conventional solid state solar cells. The key factors for efficient conversion of optical to electrical energy utilizing electrochemical solar cells are also highlighted from the point of view of barrier formation, carrier transport, and equivalent circuits. (Author)

**A79-53495** On the calculation of the temperature distribution in a packed bed for solar energy applications. H. C. White and S. A. Korpela (Ohio State University, Columbus, Ohio). *Solar Energy*, vol. 23, no. 2, 1979, p. 141-144. 18 refs.

Calculations utilizing the exact solutions for the temperature distributions of the solid in and the fluid flowing through a packed bed with arbitrary initial bed temperature and arbitrary inlet fluid temperature have been carried out. The computational method allows a reversal of the direction of the flow at arbitrary times. The influence of the nondimensional frequency of a periodic flow reversal on the bed and fluid temperatures at the steady periodic state are presented. (Author)

**A79-53496** Monolithic solar cell panel of amorphous silicon. J. J. Hanak (RCA Laboratories, Princeton, N.J.). *Solar Energy*, vol. 23, no. 2, 1979, p. 145-147. Contract No. EY-76-C-03-1286.

A monolithic solar cell panel has been fabricated using hydrogenated amorphous silicon (a-Si:H) as the semiconductor material. This device consists of a plate glass substrate bearing a number of long, narrow, parallel cells electrically connected in series along the

lengths of the cells. It features several characteristics which make it uniquely attractive for large area devices (up to several sq m) low internal power losses, due to lower current at a higher voltage, high fraction of active cell area, due to the absence of metallic grids, no basic device size limit, low cost and ease of fabrication. A device consisting of 9 cells and having an active area of 36 sq cm, open circuit voltage of 6.5 V and efficiency of 2.6 percent is described.

(Author)

**A79-53497** Load optimization in solar space heating systems. C D Barley (Solar Environmental Engineering Co., Fort Collins, Colo.) *Solar Energy*, vol 23, no 2, 1979, p 149-156 13 refs.

When load variables, such as window and insulation types, are included in the economic optimization of a solar space heating system, the overall cost is lower than that resulting from optimization of collection area for a fixed load. In this paper an algorithm is derived for choosing insulation levels, as well as solar collection area, so as to minimize the overall cost of constructing and heating a building. The general algorithm is applicable with any solar performance prediction method and with any economic criterion where the 'cost' is a linear function of collection area and of auxiliary energy consumption. A specific algorithm is also derived for active solar systems using the relative areas method of performance prediction and a conventional present worth life cycle cost analysis. The degree-day model is used for the load calculations.

(Author)

**A79-53498** Optical and thermal analysis of a Cassegrainian solar concentrator. C E Mauk, H W Prengle, Jr, and E C-H Sun (Houston, University, Houston, Tex.) *Solar Energy*, vol 23, no 2, 1979, p 157-167 15 refs. Research supported by the University of Houston, Contract No EG-77-C-01-3974.

For the storage of solar energy in a chemical system, a Cassegrainian type solar collector is investigated. With generalized geometry, a non-skew ray from the edge of the solar disc is followed through the Cassegrainian configuration to the final image to define the image height. Parametric results are presented in a form which can be used to predict performance based on off-axis optics. Equations and graphs allow the incorporation of angular error into the calculations. Slope of 5 for the limiting tangent to the hyperbolic secondary appears near optimum. The focal length of the hyperboloid is not an important factor as long as it is similar to the focal length of the paraboloid. The required diameter for the hyperboloid is typically half the diameter of the paraboloid. A set of design equations is developed, and their use is demonstrated. Design parameters are calculated for chemical reactor loads of 1.0, 0.5, and 0.1 MW.

(Author)

**A79-53522** Large aperture components for solid state laser fusion systems. W W Simmons (California, University, Livermore, Calif.) In *Electro-Optics/Laser Conference and Exposition*, Boston, Mass., September 19-21, 1978, Proceedings Chicago, Industrial and Scientific Conference Management, Inc., 1978, p 431-435 6 refs. Contract No W-7405-eng-48.

Solid state lasers for fusion experiments must reliably deliver maximum power to small (approximately 0.5 mm) targets from stand-off focal distances of 1 m or more. This requirement places stringent limits upon the optical quality, resistance to damage, and overall performance of the several major components - amplifiers, Faraday isolators, spatial filters - in each amplifier train. Component development centers about achieving (1) the highest functional material figure of merit, (2) the best optical quality, and (3) maximum resistance to optical damage. Specific examples of the performance of large aperture components will be presented within the context of the Argus and Shiva laser systems, which are presently operational at Lawrence Livermore Laboratory. Shiva comprises twenty amplifiers, each of 20 cm output clear aperture. Terawatt beams from these amplifiers are focused through two opposed, nested clusters of f/6 lenses onto such targets. Design requirements upon the larger aperture Nova laser components, up to 35 cm in clear aperture, will also be discussed, these pose a significant challenge to the optical industry.

(Author)

**A79-53545** # Evaluation of the availability of renewable energy resources on Sardinia. II - Wind energy (Sulla stima della disponibilità di energia rinnovabile nell'isola di Sardegna. II - L'energia eolica). G Pibiri, A Serra (Cagliari, Università, Cagliari, Italy), and A Sollai (Aeronautica Militare, Servizio Meteorologico, Rome, Italy) *Rivista di Meteorologia Aeronautica*, vol 39, Apr-June 1979, p 153-162 18 refs. In Italian.

Tested calculation techniques are used to estimate the available wind energy in the surface layer over Sardinia. Three regions of Sardinia have been identified as feasible for economical wind energy production: the coast, the mountainous region, and the plain of Campidano.

B J

**A79-53680** # Legal norm creation concerning solar energy in contemporary international space law. C C Okolie. In *Colloquium on the Law of Outer Space*, 21st, Dubrovnik, Yugoslavia, October 1-8, 1978, Proceedings Davis, Calif., University of California, 1979, p 40-57 59 refs.

It is suggested that the world body speed up its efforts to reach consensus on the development of solar power satellites. Emphasis is placed on the law regulating solar power satellites, United States legislative action on solar energy, and future international legal developments with regard to solar energy.

B J

**A79-53681** # The legal aspect concerning solar energy. H Safavi. In *Colloquium on the Law of Outer Space*, 21st, Dubrovnik, Yugoslavia, October 1-8, 1978, Proceedings Davis, Calif., University of California, 1979, p 67-71.

Legal aspects of solar energy utilization in airspace and in outer space are considered. It is concluded that there should be no laws constraining the technical exploitation of outer space, which should be considered a 'free zone' analogous to the high seas.

B J

**A79-53682** # Some observations of the legal implications relating to the use of solar energy. M L van Traa-Engelman. In *Colloquium on the Law of Outer Space*, 21st, Dubrovnik, Yugoslavia, October 1-8, 1978, Proceedings Davis, Calif., University of California, 1979, p 72-76 6 refs.

Different legal regimes regarding solar energy utilization are examined, with emphasis on the legal implications in the regime of outer space. It is shown that certain articles of the Space Treaty apply to solar energy utilization.

B J

**A79-53724** Gasohol for energy production. N P Cheremisinoff (Exxon Research and Engineering Co., Florham Park, New Jersey Institute of Technology, Newark, N.J.) *Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1979 147 p 53 refs \$14.95*

The book is an overview of the present state of the art as well as the potentials and uses of biomass as a source of alcohols and chemical feedstocks. Several topics are discussed, such as biomass as a source of energy, the chemistry of alcohols, methanol synthesis from synthesis gas and wood wastes, ethanol synthesis, and mass production of biomass for synthetic fuels. Also discussed are automotive uses of methanol, special uses and problems of alcohol fuels, and the development of a nationwide biomass-based alcohol-gasoline fuel system.

(Author)

**A79-53725** Solar cells for photovoltaic generation of electricity. Materials, devices and applications. M Sittig. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No 48), 1979 365 p 11 refs \$48.

The detailed, descriptive information in this book is based on U.S. patents, issued since January 1970, that deal with solar cells suitable for the photovoltaic generation of electricity. Additional material is presented concerning the principles and economics of producing electricity by means of photovoltaic cells. The discussion covers application areas of solar cells, materials for solar cells, materials availability, toxic hazards of solar-cell materials, solar cell fabrication, as well as solar cell testing, mountings and enhancement.



Also discussed are photovoltaic cogeneration (hybrid systems), photoemissive cell devices, solar cell energy storage, and photoelectrochemical energy conversion S.D.

**A79-53776 Coal conversion technology.** Edited by C. Y. Wen (West Virginia University, Morgantown, W Va) and E. S. Lee (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.) Reading, Mass., Addison-Wesley Publishing Co., Inc. (Energy Science and Technology, No. 2), 1979. 600 p. \$29.50.

Attention is given to such topics as (1) physical and chemical characterization of coal needed for the study of coal combustion and conversion systems, (2) reaction rates of coal pyrolysis and gasification, (3) coal combustion systems, (4) coal gasification for the production of high and low Btu fuels, and (5) coal liquefaction, with emphasis on principles rather than the individual or commercial processes. The material presented is intended primarily for researchers and scientists who are engaged in research, development, and design of coal combustion and conversion systems B.J.

**A79-53777 Coal classification and characterization** S. Ergun (California, University, Berkeley, Calif.) In *Coal conversion technology* Reading, Mass., Addison-Wesley Publishing Co., Inc., 1979, p. 1-56. 95 refs.

This survey paper deals with such topics as the origin of coal, its petrographic constitution and classification, and classification of coal by rank and grade. The properties of commonly used coals are discussed in detail with attention given to proximate analysis, ultimate analysis, calorific value, behavior on heating, and mechanical properties. B.J.

**A79-53778 Rates of coal pyrolysis and gasification reactions.** C. Y. Wen and S. Dutta (West Virginia University, Morgantown, W Va.) In *Coal conversion technology* Reading, Mass., Addison-Wesley Publishing Co., Inc., 1979, p. 57-170. 124 refs.

The paper examines coal pyrolysis and char-gas reactions for the purpose of assessing the available data and correlations in a systematic way and presenting these subjects in a consolidated and useful form that can be applied to combustor and gasifier designs. Coal/char pyrolysis and hydrogasification are discussed in greater detail than the other char-gas reactions. Models for determining the rate constants of such reactions are investigated B.J.

**A79-53779 Coal combustion.** R. H. Essenhigh (Ohio State University, Columbus, Ohio) In *Coal conversion technology* Reading, Mass., Addison-Wesley Publishing Co., Inc., 1979, p. 171-312. 179 refs.

The behavior of coal-fired systems is assessed from the operational point of view. The approach is used to describe existing coal-fired systems, the essentials of the equipment used, the present understanding of how these systems behave, and present knowledge of the underlying principles B.J.

**A79-53780 Coal gasification for high and low Btu fuels.** L. G. Massey (Consolidated Natural Gas Service Co., Inc., Cleveland, Ohio) In *Coal conversion technology* Reading, Mass., Addison-Wesley Publishing Co., Inc., 1979, p. 313-427. 107 refs.

This survey paper on coal gasification discusses such topics as the general character of coals, gasification principles, gasifiers, and gasifier heat supply methods. Consideration is also given to low Btu gasification, intermediate and high Btu gasification, construction materials, environmental issues, and prospects for coal gasification B.J.

**A79-53781 Coal liquefaction** E. S. Lee (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.) In *Coal conversion technology* Reading, Mass., Addison-Wesley Publishing Co., Inc., 1979, p. 428-545. 119 refs.

After a brief review of the historical development of liquefaction, attention is given to various aspects and characteristics of the

coal liquefaction process, including direct liquefaction, hydrodesulfurization of coal and hydrogen requirement, pyrolysis, and indirect liquefaction. Consideration is also given to the effect of coal properties on liquefaction, solvent extraction or dissolution, kinetics or solvent extraction, catalytic hydrogenation, and properties and purifications of liquefaction products. B.J.

**A79-53804 Pollutant protection for the case of strip mining in the Rhine area (Immissionsschutz in den Braunkohlentagebauen des Rheinischen Reviers).** H.-J. Thiede *Energiewirtschaftliche Tagesfragen*, vol. 29, Sept. 1979, p. 535-541. 8 refs. In German.

**A79-53805 Energy conservation - Focal point for energy efficient operations (Die Einsparung von Energie - ein Schwerpunkt energiewirtschaftlicher Aufgaben).** P. Schnell and M. Dehli (Energie-Versorgung Schwaben AG, Stuttgart, West Germany) *Energiewirtschaftliche Tagesfragen*, vol. 29, Sept. 1979, p. 546-552. 13 refs. In German.

**A79-53938 \* A device model for the tandem junction solar cell.** W. T. Matzen, S. Y. Chiang, and B. G. Carbajal (Texas Instruments, Inc., Dallas, Tex.) *IEEE Transactions on Electron Devices*, vol. ED-26, Sept. 1979, p. 1365-1369. 8 refs. Research sponsored by the U.S. Department of Energy and NASA.

A conceptual device model has been developed to explain operation of the tandem junction cell (TJC) when back contacts only are used. Operation and parameters of the cell are explained by transistor action. Experimental observations are presented which confirm that current is collected for carrier generation in the front uncontacted n(+)-region. The model should be useful as a guideline to optimize the TJC by application of transistor design principles (Author)

**A79-54188 Magnetoacoustic oscillations in a finite-beta current carrying plasma column.** M. L. Sawley (South Australia, Flinders University, Bedford Park, Australia) *Journal of Plasma Physics*, vol. 22, Oct. 1979, p. 223-229. 11 refs.

Forced magnetoacoustic oscillations in a fully ionized, non-uniform, current carrying plasma column of finite beta are treated theoretically. The results of numerical calculations are given for the specific case of diffuse pinch equilibrium configurations. It is found that, for these configurations, the amplitude of the axial component of the oscillating magnetic field is enhanced and the frequency at which magnetoacoustic resonance occurs is raised. It is also found that the presence of an equilibrium axial current produces a substantial azimuthal component, in addition to the axial component, of the oscillating magnetic field (Author)

**A79-54278 Consumers' responses to fuel-efficient vehicles - A critical review of econometric studies.** K. Train (Cambridge Systematics, Inc., Berkeley, Calif.) *Transportation*, vol. 8, Sept. 1979, p. 237-258. 48 refs.

The paper examines past economic research on automobile demand and its effect on consumers' response to fuel-efficient vehicles. Three types of econometric research are reviewed, aggregate econometric studies, disaggregate econometric studies with models of automobile ownership and class choice, and hedonic price analyses. Each category is analyzed to determine how consumers will respond to the introduction of fuel-efficient vehicles. It is shown that all of the studies provide inadequate information due to insufficient variation and too large covariation among automobile prices, fuel efficiency, weight, and size. Because of this problem, current econometric approaches cannot obtain reliable estimates of consumers' responses to changes in automobile characteristics. A disaggregate model estimated with a large number of alternatives and no alternative-specific constants, and an experimental method of describing a set of hypothetical automobiles to a consumer and asking him which set he prefers are proposed to alleviate these problems A.T.

**A79-54294** The photochemical reaction applied to a multiply hybridized water-splitting system T Ohta, N Kamiya, and T Otagawa (Yokohama National University, Yokohama, Japan) *International Journal of Hydrogen Energy*, vol 4, no 4, 1979, p 255-266. 5 refs. Research supported by the Ministry of International Trade and Industry.

Application of the photochemical reaction  $2\text{Fe}(2+) + \text{I}_3(-) + \text{light}$  yields  $2\text{Fe}(3+) + 3\text{I}(-)$  to the water splitting cycles hybridized by photochemical, electrochemical, and thermochemical reactions is examined. The theoretical expression for the conversion efficiency of light energy to chemical energy is derived using reaction dynamics, and the factor which maximizes it and the Gibbs free energy change are investigated. It was found that the magnitude of stored energy depends on the intensity of light, the concentration of the reactants, and the type of anions in solution. The  $\text{SO}_4(2-)$  system yields a large value of the Gibbs free energy change when the reactivity of the photochemical process and the retardation of the back reaction are considered, a value of 15 to 20% is obtained for the efficiency of the photochemical conversion process. A T

**A79-54296** Sb-I-Ca process for thermochemical hydrogen production N Miura, N Yamazoe, and T Seiyama (Kyushu University, Fukuoka, Japan) *International Journal of Hydrogen Energy*, vol 4, no 4, 1979, p 279-286. 12 refs.

A new thermochemical water-splitting process named 'Sb-I-Ca Process' is described with relevant thermochemical data and preliminary experimental results. The process, which is an improved version of the 'Sb-I Process' previously proposed, consists of basic steps involving five reactions and three phase transitions. It was found that all reaction and separation steps in this process could be conducted without serious difficulties. From a flow diagram made on the basis of the experimental results, the overall efficiency was estimated to be about 40%, with an assumption of 70% heat recovery. (Author)

**A79-54297 \*** Hydrogen-fueled diesel engine without timed ignition H S Homan, P C T de Boer, J J McLean (Cornell University, Ithaca, N Y), and R K Reynolds (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *International Journal of Hydrogen Energy*, vol 4, no 4, 1979, p 315-325. 15 refs.

Experiments were carried out to investigate the feasibility of converting a diesel engine to hydrogen fueled operation without providing a timed ignition system. Use was made of a glow plug and a multiple-strike spark plug. The glow plug was found to provide reliable ignition and smooth engine operation. It caused the hydrogen to ignite almost immediately upon the start of injection. Indicated mean effective pressures were on the order of 1.3 MPa for equivalence ratios between 0.1 and 0.4 at a compression ratio of 18. This is significantly higher than the corresponding result obtained with diesel oil (about 0.6 MPa for equivalence ratios between 0.3 and 0.9). Indicated thermal efficiencies were on the order of 0.4 for hydrogen and 0.20-0.25 for diesel oil. Operation with the multiple strike spark system yielded similar values for IMEP and efficiency, but gave rise to large cycle-to-cycle variations in the delay between the beginning of injection and ignition. Large ignition delays were associated with large amplitude pressure waves in the combustion chamber. The measured  $\text{NO}(x)$  concentrations in the exhaust gas were of the order of 50-100 ppm. This is significantly higher than the corresponding results obtained with premixed hydrogen and air at low equivalence ratios. Compression ignition could not be achieved even at a compression ratio of 20. (Author)

**A79-54298** Proton conduction in some solids and the fuel cell with a proton conducting electrolyte. T Takahashi, S Tanase, O Yamamoto, S Yamauchi, and H Kabeya (Nagoya University, Nagoya, Japan) *International Journal of Hydrogen Energy*, vol 4, no 4, 1979, p 327-338. 32 refs.

The electrical conductivities of some organic and inorganic solids, such as the simple organic acids,  $\text{NH}_4\text{H}_2\text{PO}_4$ ,  $\text{KH}_2\text{PO}_4$ ,  $\text{H}_3\text{BO}_3$ ,  $\lambda\text{-AlOOH}$ , amine sulfates and amine phosphates, have

been measured. A relatively high proton conductivity of about  $10^{-3}$  ohm per cm at 87°C was found in hexamethylenetetramine phosphate. The performance of a hydrogen-air fuel cell with proton conducting solid electrolytes has been measured at 174°C. The open-circuit voltage of the cell was 960 mV and the short-circuit current was 6 mA/sq cm. (Author)

**A79-54337 \*** Research on fission induced plasmas and nuclear pumped lasers at the Los Alamos Scientific Laboratory H H Helmick (California University, Los Alamos Scientific Laboratory, Los Alamos, N Mex.) In *International Symposium on Nuclear Induced Plasmas and Nuclear Pumped Lasers*, 1st, Orsay, Essonne, France, May 23-25, 1978, Proceedings. Orsay, Essonne, France, Les Editions de Physique Z I de Courtaboeuf, 1979, p 145-162. 12 refs. Research sponsored by the US Department of Energy. NASA Order W-13755.

A program of research on gaseous uranium and uranium plasmas is being conducted at The Los Alamos Scientific Laboratory under sponsorship of the National Aeronautics and Space Administration. The objective of this work is twofold: (1) to demonstrate the proof of principle of a gaseous uranium fueled reactor, and (2) pursue fundamental research on nuclear pumped lasers. The relevancy of the two parallel programs is embodied in the possibility of a high-performance uranium plasma reactor being used as the power supply for a nuclear pumped laser system. The accomplishments in the two above fields are summarized. (Author)

**A79-54350** Some aspects of a fission-based plasma engine J Kistemaker (Stichting voor Fundamenteel Onderzoek der Materie, Instituut voor Atoom- en Molecuulfysica, Amsterdam, Netherlands) In *International Symposium on Nuclear Induced Plasmas and Nuclear Pumped Lasers*, 1st, Orsay, Essonne, France, May 23-25, 1978, Proceedings. Orsay, Essonne, France, Les Editions de Physique Z I de Courtaboeuf, 1979, p 333-354. 21 refs. Research supported by the Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek.

The problem that energy conversion methods use thermal conversion, but never the high kinetic energies from primary reactions in the burning fuel is addressed. It is noted that the reason for such conservatism is corrosion trouble above 1300 K. Attention is given to energy extraction by induction covering Colgate's original idea, the gas-core oscillator, heat balance inside a high density plasma, and criticality of the gas mixture. It is concluded that a gas core fission reactor operating at very high temperatures (25,000 K) seems to be possible in principle if a mixture of UF<sub>4</sub> plus CF<sub>4</sub> is used. The quantity of fuel in the reactor would be of the order of 25 to 100 kg. Plutonium would recirculate until it fissioned, and the radioactive waste would be relatively short lived as it would not contain actinides. M E P

**A79-54351** Gaseous fuel reactor applications. J S Kendall (United Technologies Research Center, East Hartford, Conn.) In *International Symposium on Nuclear Induced Plasmas and Nuclear Pumped Lasers*, 1st, Orsay, Essonne, France, May 23-25, 1978, Proceedings. Orsay, Essonne, France, Les Editions de Physique Z I de Courtaboeuf, 1979, p 355-367. 8 refs.

Conceptual designs and performance estimates for two types of gaseous-fuel nuclear fission reactors which could be used as electric generators or high-temperature thermal energy sources are presented. In the mixed-flow reactor, a UF<sub>6</sub>/helium gas mixture is injected tangentially into a cylindrical cavity in order to establish a vortex flow. Different temperature flows are exhausted from the cavity to provide a mixed exhaust flow temperature compatible with a high-temperature heat exchanger. In a plasma core reactor, energy is transferred by thermal radiation from a region of hot (15,000 to 30,000 K) gaseous U-233 contained within a buffer gas vortex to a helium working fluid located near the cavity periphery. The power

## A79-54504

extraction system concepts for the reactors utilize closed-loop flowing circuits incorporating a helium gas turbine. Efficiencies of gaseous fuel reactor systems are shown to be high with resulting minimal environmental effects. A present NASA-sponsored research program includes experiments on fission in static and flowing UF<sub>6</sub> and buffer-gas-confined UF<sub>6</sub> cavity reactor experiments. A L W

**A79-54504**      **Synthetic test methods of high-direct-current circuit breaker** R Shimada, K Tani, H Kishimoto, S Tamura (Japan Atomic Energy Research Institute, Tokyo, Japan), H Ikeda, T Tamagawa, S Yanabu, and T Matsushita (Toshiba Corp., Kawasaki, Japan) *Institution of Electrical Engineers, Proceedings*, vol 126, Oct 1979, p 965-970 10 refs

Three synthetic test methods, using a short-circuit generator as a current source, were investigated for high-dc circuit breakers: (1) a test method using equivalent alternating voltage, (2) a simplified synthetic test method, and (3) a practical synthetic test method. The test method which adopted a capacitor bank for a voltage supply was recognized to be equivalent to a practical system. With this test method, a dc circuit breaker with vacuum interrupters was tested up to 130 kA/44 kV. These breakers are used with an ohmic heating power supply of an inductive energy storage system for a tokamak device. B J

## STAR ENTRIES

**N79-28213#** Aerospace Corp El Segundo Calif Space Sciences Lab

### ENVIRONMENTAL FACTORS OF POWER SATELLITES Interim Report

Yam T Chiu and Barbara K Ching 6 Jul 1979 49 p refs (Contract F04701-78 C-0079)

(SAMSO-TR-79-66, TR-0079(4960-04)-5) Avail NTIS HC A03/MF A01

All presently known factors in the construction and operation of the proposed solar power satellite which may produce effects on the environment from ground level to beyond the magnetopause are reviewed. Characteristics of the propulsion system exhausts of the space segment, the microwave beam, the satellite physical structure, and the HLLV launch and landing activities are described. A R H

**N79-28229#** California Univ Livermore Lawrence Livermore Lab

### ON-LINE TESTS OF ORGANIC ADDITIVES FOR THE INHIBITION OF THE PRECIPITATION OF SILICA FROM HYPERSALINE GEOTHERMAL BRINE

J E Harrar F E Locke L E Lorensen C H Otto, Jr. S B Deutscher, W P Frey, and R Lim 3 Apr 1979 27 p refs (Contract W-7405-eng-48)

(UCID-18091) Avail NTIS HC A03/MF A01

A number of compounds were screened as potential scale control agents by examining their effect on the precipitation of silica from Magmamax No 1 brine. Solutions of the test substances were injected into flowing brine at approximately 200 C. The brine was flashed at 125 C, and then the kinetics of solids and silica precipitation from effluent brine held at 90 C were measured. Compounds tested include a variety of cellulose derivatives, ethylene oxide polymers, several polyethoxylated surfactants, and a phosphonate. The ethylene oxide moiety was confirmed as the source of activity in substances that inhibit the precipitation of silica at 90 C, and the polyethylene glycols in the molecular weight range of approximately 10,000 to 100,000 are the most effective. A brief, in-plant scaling test with the most promising precipitation inhibitor showed that, although it significantly retarded scaling at 90 C, there was no improvement at 125 C or higher, and at 125 C there may have been a slight increase in scaling rate. DOE

**N79-28252** California Univ Berkeley

### SOLVENT SELECTIVITY FOR PURIFICATION OF NATURAL CASES Ph.D Thesis

Orlando Rafael Rivas 1978 122 p

Avail Univ Microfilms Order No 7914742

A gas solubility apparatus was developed for measuring the solubility of gases in pure or mixed solvents at pressures below one atmosphere and at temperatures ranging from -20 to 200 C. Equilibrium solubilities accurate to about one percent are determined from total gas pressure and from material balances. This apparatus was used for research on purification of sour natural gases by absorption. The absorbing liquid was a mixture containing one chemical solvent and one physical solvent. Preliminary design calculations for sweetening natural gases by absorption suggest that under some circumstances mixed solvent absorption may be economically superior to absorption using conventional aqueous alkanolamine solutions. Dissert Abstr

### N79-28314\*# Jet Propulsion Lab Calif Inst of Tech Pasadena DEVELOPMENT AND EVALUATION OF ELASTOMERIC MATERIALS FOR GEOTHERMAL APPLICATIONS Annual Report, Oct 1977 - Dec 1978

W A Mueller S H Kalfayan, W W Reilly A H Yavrouian, I D Mosesman and J D Ingham 15 May 1979 45 p refs Prepared for NASA and DOE

(Contract NAS7-100)

(NASA-CR-158813 JPL-PUB-79-40 DGE/1026-2) Avail NTIS HC A03/MF A01 CSCL 11G

A material was formulated having about 250-350 psi tensile strength and 30-80 percent elongation at 260 C for at least 24 hours in simulated brine. The relationship between these laboratory test results and sealing performance in actual or simulated test conditions is not entirely clear, however, it is believed that no conventional formation or casing packer design is likely to perform well using these materials. The synthetic effort focused on high temperature block copolymers and development of curable polystyrene. Procedures were worked out for synthesizing these new materials. Initial results with heat-cured unfilled polystyrene gum at 260 C indicate a tensile strength of about 50 psi. Cast films of the first sample of polyphenyl quinoxaline polystyrene block copolymer which has graft-block structure consisting of a polystyrene chain with pendant polyphenyl quinoxaline groups show elastomeric behavior in the required temperature range. Its tensile strength and elongation at 260 C were 220-350 psi and 18-36 percent respectively. All of these materials also showed satisfactory hydrolytic stability. A R H

**N79-28343** Pennsylvania State Univ University Park

### SOME ASPECTS OF THE MECHANISM AND KINETICS OF COAL LIQUEFACTION Ph.D Thesis

Adam J Szladow 1979 185 p

Avail Univ Microfilms Order No 7915743

The relationships between the generation of materials of different solubilities and the removal of oxygen functional groups for coal/tetralin interactions, at temperatures 340-400 C and relatively short times, were studied to provide quantitative information helpful in assessing various hypotheses about the role of oxygen functional groups in the early stages of liquefaction. Studies of the effect of temperature on rates of conversion were performed with the object of shedding additional light on the reactions taking place during short contact times. Mathematical treatment of the kinetics of complex reaction mixtures, specifically the analysis of activation energies were extended from what was known from the literature in order to apply it to coal liquefaction. Dissert Abstr

**N79-28346#** Committee on Commerce, Science, and Transportation (U S Senate)

### LIQUEFIED NATURAL GAS SAFETY, SITING, AND POLICY CONCERNS

Washington GPO 1978 156 p refs Rept for Comm on Commerce, Sci and Transportation, 95th Congr, 2d Sess, Jun 1978

(GPO-26-349) Avail SOD HC

The policy concerns associated with liquid natural gas (LNG) import industry are discussed as well as the issues associated with LNG safety, siting, and regulatory factors. M M M

**N79-28347#** Committee on the District of Columbia (U S House)

### NATURAL GAS SHORTAGE

Washington GPO 1977 142 p Oversight hearings before the Subcomm on Economic Development and Regional Affairs of the Comm on the District of Columbia, 95th Congr, 1st Sess 2 Mar and 5 Apr 1977

(GPO-86-231) Avail Subcomm on Economic Development and Regional Affairs

Testimony was given on the gas shortage that occurred during the winter of 1976-77, in the states served by the Columbia Gas Transmission Corporation. The management of local crisis as well as the economic impact of the shortage was discussed. Improvement on the coordination among local jurisdictions in preparing for other emergencies was stressed. M M M

**N79-28348#** Committee on Commerce Science and Transportation (U S Senate)

**DIESEL FUEL AND GASOLINE CONSERVATION ACT OF 1977**

Washington GPO 1978 92 p refs Hearing on S 1699 before the Comm on Commerce, Sci and Transportation 95th Congr 2d Sess, 14 Sep 1978 (GPO-34-986) Avail Comm on Commerce, Sci and Transportation

Testimony was given and a bill amendment was proposed to section 382 of the Energy Policy and Conservation Act of 1975 to alleviate current and continuing fuel waste, to reduce empty vehicle movements and to increase efficiency in transporting goods by motor carriers which benefit consumers and for other purposes M M M

**N79-28349\*#** National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

**USE OF REFINERY COMPUTER MODEL TO PREDICT FUEL PRODUCTION**

Francisco J Flores Jun 1979 25 p refs (NASA-TM-79203 E-088) Avail NTIS HC A02/MF A01 CSCL 21D

Several factors (crudes refinery operation and specifications) that affect yields and properties of broad specification jet fuel were parameterized using the refinery simulation model which can simulate different types of refineries were used to make the calculations Results obtained from the program are used to correlate yield as a function of final boiling point, hydrogen content and freezing point for jet fuels produced in two refinery configurations each one processing a different crude mix Refinery performances are also compared in terms of energy consumption A R H

**N79-28351#** Congressional Budget Office Washington, D C **REPLACING OIL AND NATURAL GAS WITH COAL PROSPECTS IN THE MANUFACTURING INDUSTRIES**

Aug 1978 94 p refs Avail NTIS MF A01 SOD HC

The likely impact of alternative federal policies aimed at encouraging the use of solid coal instead of oil and natural gas in manufacturing industries is discussed An overview of the oil and gas consumption in the industrial sector is presented and the cost factors that enter into the selection of new boiler equipment and fuel are analyzed Assumptions concerning future environmental regulations and cost data for air pollution control equipment are examined as well as the technical feasibility for coal substitution in nonboiler uses Industrial demand for coal for boilers is estimated (if current policies were continued), and the sensitivity of these estimates to changes in key assumptions are specified The effects of alternative coal substitution policies on energy use and on the federal budget are also assessed A R H

**N79-28355#** Massachusetts Inst of Tech, Cambridge Energy Lab

**ESTIMATION METHODOLOGY FOR ENERGY SUPPLY FROM NATURAL RESOURCES Final Report**

Esteban Hnyiliczka Nov 1978 429 p refs (EPRI Proj 871-1) (EPRI-EA-788) Avail NTIS HC A19/MF A01

The feasibility of developing improved methodologies for the estimation of reserves and for the forecasting of long term supply of subsoil energy resources was investigated It was concluded that the development of improved tools for between the conceptual strengths of the economic theory of exhaustible resources and the relevance and realism of empirically based methodologies of model building The application of the principles of systems science, so as to judiciously incorporate the geological technological and behavioral determinants of resource exploitation, constitutes the most promising avenue toward achieving the above synthesis Prototype models which serve to illustrate the potentialities of this methodology are presented The models address the exploration and production of petroleum at the field and industry levels DOE

**N79-28356#** Department of Energy Washington D C Energy Information Administration

**PETROLEUM SUPPLY/DEMAND ESTIMATES AND COST OF PETROLEUM IMPORTS, 1978-1980**

Ercan Tukenmez and Cornelius Dwyer Dec 1978 26 p refs (DOE/EIA-0102/20) Avail NTIS HC A03/MF A01

Results of the analysis show that petroleum imports to the 50-State/D C area covered by the DOE import statistics are expected to average 8.1 to 8.3 million barrels daily in 1978 The cost of petroleum imports to the U S balance of payments area, including net imports to U S territories such as Puerto Rico and Virgin Islands is expected to be \$44 to \$45 billion in 1978 expressed in constant dollars observed in the first half of 1978 Imports into the 50-State/D C area are expected to rise to the range of 9 to 9.4 million barrels daily in 1979 and to 10 to 10.6 million barrels daily in 1980 The cost of imports to the balance of payments area is expected to range between \$49 to \$51 billion in 1979 and between \$54 and \$57 billion in 1980 in the first half of 1978 dollars DOE

**N79-28357#** North Dakota Univ Grand Forks

**CHEMISTRY OF LIGNITE LIQUEFACTION Quarterly Report, Apr - Jun 1978**

Virgil I Stenberg Richard J Baltisberger Kenneth J Klabunde Neil F Woolsey Donald Severson and Max Souby Jul 1978 50 p refs (Contract EX-76-C-01-2211) (FE-2211-10) Avail NTIS HC A03/MF A01

Lignite liquefaction was investigated Emphasis was placed on development of analytical methods for the structural analysis of solvent refined lignite (SRL) and its reduction products application of the developed analytical methods to and CO-H2O reducing systems Results are reported J M C

**N79-28358#** Institute of Gas Technology, Chicago Ill **RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS Annual Report, 1 Apr 1977 - 31 Mar 1978**

Dennis A Duncan Justin L Beeson and R Donald Oberle Aug 1978 101 p refs (Contract EX-76-C-01-2307) (FE-2307-34) Avail NTIS HC A06/MF A01

Runs were made in the bench-scale unit using power plant grind of lignite and hydrogen The main products obtained were methane ethane carbon oxides and hydrocarbon liquids The thermal treatment of the reactants for all runs was characterized by a kinetic severity function which is a measure of the products of a first order decomposition rate constant and the time interval that the reactants are exposed to the reaction environment Overall correlation with kinetic severity function was found to be a reasonable predictor for carbon conversion and methane yields Initial work with liquids composition data shows that liquids composition does not correlate as well with kinetic severity function, indicating that other factors, such as reactions in sequence, influence liquids composition DOE

**N79-28360#** Institute of Gas Technology, Chicago Ill **HYDROGEN FROM EXISTING FALLING-WATER SITES AN INITIAL FEASIBILITY ASSESSMENT (SUMMARY)**

Dale G Johnson William J D Escher and Jon B Pangborn 1978 11 p refs Presented at DOE Chem Energy Storage and Hydrogen Energy Systems Contracts Rev Washington D C 28-30 Nov 1978 (Contract EY-76-C-02-0016) (CONF-781142-8) Avail NTIS HC A02/MF A01

When viewed on a macroscopic scale, falling-water hydrogen cannot be a major contributor in strengthening the nation's energy base However when viewed on a regional or mini-regional scale there appears to be strong possibilities that falling-water hydrogen can become an economic reality in the near term as a high-value commodity that would serve as a replacement in part for steam-reformed natural gas, and in the future as an economic gas supplement through direct injection into the natural gas distribution system Although appearing favorable the characteristic seasonal-yearly variation in hydrogen production may or may

not diminish the economic attractiveness of falling-water hydrogen. This will depend upon specific local market or energy demands and their relative location to the resource and the associated cost of storage and delivery. DOE

**N79-28361#** SRI International Corp., Menlo Park, Calif  
**MISSION ANALYSIS FOR THE FEDERAL FUELS FROM BIOMASS PROGRAM. VOLUME 5: BIOCHEMICAL CONVERSION OF BIOMASS TO FUELS AND CHEMICALS**  
Jerry L Jones, W S Fong, F A Schooley, and R L Dickenson  
Dec 1978 203 p refs  
(Contract EY-76-C-03-0015-131)  
(TID-29093-Vol-5) Avail NTIS HC A10/MF A01

In the analysis of the anaerobic digestion options, specific feedstocks, including animal manure, wheat straw, and marine algae (giant kelp), are considered on a case basis. The processes are described, investment and operating costs estimated, and the availability and reliability of the technology and environmental considerations briefly discussed. The analysis of the fermentation of biomass feedstocks to ethanol from sugars and the actual production of the sugars are described. After describing the process for fermentation of sugars to alcohol, estimating investment and operating costs, and commenting on the availability and reliability of the technology and environmental considerations, a number of alternative feedstocks and processes for producing the fermentable sugar solutions are examined. These processes for producing the sugar solutions are examined in a manner comparable with that mentioned above. The feedstocks included in the analysis are sugar cane, wheat straw, and aquatic biomass. DOE

**N79-28362#** Argonne National Lab., Ill. Materials Science Div  
**MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES** Quarterly Report, Jul - Sep 1978  
W A Ellingson 1978 71 p refs  
(Contract W-31-109-eng-38)  
(ANL-79-2, QR-15) Avail NTIS HC A04/MF A01

An evaluation of ceramic refractories for slagging gasifiers and fused cast chrome alumina are presented along with ultrasonic erosion detection systems and data acquired during a plant run at Bt-Gas. DOE

**N79-28363#** Utah Univ., Salt Lake City Dept of Mining, Metallurgical and Fuels Engineering  
**APPLIED RESEARCH AND EVALUATION OF PROCESS CONCEPTS FOR LIQUEFACTION AND GASIFICATION OF WESTERN COALS** Quarterly Progress Report, Jul. - Sep. 1977

Wendell H Wiser Apr 1978 102 p  
(Contract EX-76-C-01-2008)  
(FE-2006-9) Avail NTIS HC A06/MF A01

Studies on the extraction of coal with tetralin show that high volatile bituminous coal is converted to oil and benzene and pyridine solubles in less than 2 minutes. The products show systematic changes in hydroaromatic and aliphatic structures as the reaction proceeds. The presence of aromatic ring structures increases with reaction time. The molecular weight of liquid products decreases with reaction time. Mild hydrolysis appears to be a very interesting technique for upgrading coal-derived liquids to a lighter liquid. Hydrogen consumption in this process is low. Zinc chloride impregnated on coal was found to have hydrogen exchange properties of a Bronsted acid. A coal sample without ZnCl<sub>2</sub> has similar exchange properties, but the rate is much less. The acidic oil fraction obtained by catalytic hydrogenation of coal was separated by gel permeation chromatography and gradient elution liquid chromatography. Function group content was found to be independent of molecular size. DOE

**N79-28364#** Metal Properties Council, Inc., New York  
**PROGRAM TO DISCOVER MATERIALS SUITABLE FOR SERVICE UNDER HOSTILE CONDITIONS OBTAINING IN MATERIALS FOR THE GASIFICATION OF COAL AND OTHER SOLID FUELS** Quarterly Progress Report, 1 Jan. - 31 Mar 1978

A O Schaefer, ed May 1978 172 p  
(Contract EX-76-C-01-1784)  
(FE-1784-39) Avail NTIS HC A08/MF A01

The materials for use in coal gasification plants with respect to the various unique corrosive environments were screened to provide useful corrosion data as well as reliable information on other properties needed for the design, construction, and operation of such plants. DOE

**N79-28398#** Sandia Labs., Albuquerque, N Mex. Antenna Development Div  
**SCATTERED EM FIELD DUE TO ROTATING BLADES OF HORIZONTAL-AXIS WIND MACHINES**  
Billy C Brock Mar 1979 35 p refs  
(Contract EY-76-C-04-0789)  
(SAND-79-0434) Avail NTIS HC A03/MF A01

An analysis of the scattered electromagnetic field from the rotating blades of a horizontal axis wind machine is presented. The general analysis includes all of the near field terms and does not specify the blade geometry. After the general result is developed, appropriate approximations were made and a simple blade geometry was specified in order to simplify numerical calculations. (The simple blade geometry includes blade pitch angle and coning angle). Graphs of the magnitude vs time of the total horizontally polarized electric field resulting from a horizontally polarized incident plane wave are given for various parameters. The FORTRAN computer code used to generate the results is also listed. DOE

**N79-28439#** Brookhaven National Lab., Upton, N Y  
**HIGH VOLTAGE INSULATION AND BUSHING DESIGN FOR FLEXIBLE SUPERCONDUCTING CABLES**

A J McNerney 1979 19 p refs. Presented at the EPRI Sem on Solid Dielectric Mater Appl to the Elec Power Ind., Monterey, Calif., 24-26 Jan 1979  
(Contract EY-76-C-02-0016)  
(BNL-25351, Conf-790141-1) Avail NTIS HC A02/MF A01

Design details are presented for the high voltage insulation and feedthrough bushing for a flexible, superconducting, helium-cooled, 138 kV power transmission cable. The cable when installed will have helium at 15 atmospheric pressure and 6 to 8 K temperature flowing in the hollow cable core. The insulation requirements were met by a dielectric lapped from laminated tapes made from commercially available oriented polyethylenes and polypropylenes. Epoxy bushings were chosen for further development. DOE

**N79-28441#** Market Facts, Inc., Washington D C  
**HIGH-EFFICIENCY ELECTRIC MOTORS FOCUS GROUP RESULTS**

Aug 1978 39 p  
(Contract EV-78-C-01-6458)  
(DOE/TIC-10005) Avail NTIS HC A03/MF A01

The question of whether high-efficiency electric motors represent an appropriate energy conservation technology for DOE commercialization efforts is addressed and these issues are covered: (1) feasibility of the commercialization of high-efficiency motors, (2) extent and nature of the market of these motors, (3) barriers and opportunities identified as critical to the commercialization of these motors and the relative importance of each, and (4) what actions, if any, should the Federal government take to promote commercialization. DOE

**N79-28470#** Grumman Aerospace Corp., Bethpage, N Y  
**CRYOGENIC THERMAL DIODE HEAT PIPES** Final Report  
J Alario Feb 1979 59 p refs  
(Contract NAS2-7492)  
(NASA-CR-152268) Avail NTIS HC A04/MF A01 CSDL 200

The development of spiral artery cryogenic thermal diode heat pipes was continued. Ethane was the working fluid and stainless steel the heat pipe material in all cases. The major tasks included: (1) building a liquid blockage (blocking orifice)

thermal diode suitable for the HEPP space flight experiment  
(2) building a liquid trap thermal diode engineering model  
(3) retesting the original liquid blockage engineering model, and  
(4) investigating the startup dynamics of artery cryogenic thermal diodes. An experimental investigation was also conducted into the wetting characteristics of ethane/stainless steel systems using a specially constructed chamber that permitted in situ observations  
G Y

**N79-28506#** Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)  
**AERODYNAMIC SEPARATION OF GASES AND ISOTOPES-RECENT ADVANCES**

1978 592 p refs Lecture held at Rhode-Saint-Genese, Belgium, 29 May - 2 Jun 1978

(VKI-Lecture-Series-1978-8) Avail NTIS HC A25/MF A01

A lecture series on aerodynamic methods which have been used to separate or have been proposed for separating uranium isotopes in UF<sub>6</sub> is presented

**N79-28521#** California Univ, Livermore Lawrence Livermore Lab

**DEVELOPMENT OF MECHANISTIC THEORY FOR DRYING OF POROUS MEDIA USING TWO-FLUID, TWO-PHASE FLOW THEORY**

R W Lyczkowski 15 Mar 1979 31 p refs Presented at 2d Multiphase Flow and Heat Transfer Symp Workshop, Miami Beach, Fla, 16 Apr 1979

(Contract W-7405-eng-48)

(UCRL-81604, Conf-790423-5) Avail NTIS

HC A03/MF A01

A mechanistic phenomenological model for drying of porous media was established for a single representative pore by applying two-fluid two-phase flow theory. The model rationally extends classical drying theory to handle rapid drying of moist solids where bulk motion of vapor and liquid water occurs within the drying matrix. The new model was developed to gain insight into the moisture dynamics of wet Western United States coals undergoing underground coal gasification. Simplifications were made to compare with other theories and models proposed or assumed in the literature to assess their correctness. Explicit expressions were also obtained for the evaporation rate and phase permeabilities. The extension to a global drying model was made  
DOE

**N79-28540#** Sandia Labs, Albuquerque, N Mex  
**LASER DEVELOPMENT FOR LASER FUSION APPLICATIONS Progress Report, Apr. - Sep. 1978**

Dec 1978 77 p refs

(Contract EY-76-C-04-0789)

(SAND-78-2306) Avail NTIS HC A05/MF A01

Three high power laser systems were discussed: iodine HF, and GROUP IV atoms. Both the iodine lasers and the HF laser possess high power capability and show promise in the laser fusion applications. The technical progress of these programs was pointed out  
DOE

**N79-28592#** Bureau of Mines, Albany Oreg Metallurgy Research Center

**EROSION TESTING OF POTENTIAL VALVE MATERIALS FOR COAL GASIFICATION SYSTEMS**

J S Hansen, J E Kelley and F W Wood 1979 32 p refs (PB-293308/3, BM-RI-8335) Avail NTIS HC A03/MF A01 CSCL 13K

In support of its objective to conserve mineral resources by minimizing premature failure of materials, the Bureau of Mines conducted a cooperative study with the U S Department of Energy on the erosion and abrasion resistance of hard materials for valves in coal conversion systems. A developed erosion-testing apparatus is described and data on the erosion resistance of over 200 materials are presented. Erosion resistance of most metals was comparatively low. In contrast, ceramics and cermets

such as B<sub>4</sub>C, WC, SiC, Si<sub>3</sub>N<sub>4</sub>, and TiB<sub>2</sub>, when fabricated to minimize porosity, displayed greater than five times the erosion resistance of metals. Coatings such as boron diffused into Mo and WC, chemical-vapor-deposited TiCN, and electrodeposited TiB<sub>2</sub> were highly erosion resistant if applied in thicknesses ranging from 60 to 75 micrometers. Erosion resistance of cemented carbides was inversely related to metal binder content  
GRA

**N79-28594#** Little (Arthur D), Inc, Cambridge, Mass  
**EVALUATION OF AUTOMOBILE DRIVETRAIN COMPONENTS TO IMPROVE FUEL ECONOMY Final Report, Jun 1975 - Nov. 1977**

Donald Hurter and Philip Gott Mar 1979 114 p refs

(Contract DOT-TSC-1046)

(PB-293728/2, DOT-TSC-NHTSA-79-12, DOT-HS-803-840)

Avail NTIS HC A06/MF A01 CSCL 13F

Wide ratio range automatic transmissions with lockup torque converters could be in production by the early 1980's. In order to evaluate their impact upon fuel economy, emissions, driveability, acceleration, and durability, four 1975 automobiles with inertia weights and engine sizes typical of that time period were equipped with Multi-Purpose Test Transmissions. Each of the test cars was evaluated in seven different transmission modes for fuel economy, emission, driveability, acceleration and durability. Fuel economy test results were compared to computer predicted fuel economies. Predicted values agreed with actual fuel economies within the resolution of the test method. Composite fuel economy improvements of up to 14% were achieved with no change in acceleration and durability  
GRA

**N79-28596#** South Coast Technology Inc, Santa Barbara, Calif  
**ALTERNATE ENGINES STATE OF THE ART STUDY Final Report, Nov 1977 - Nov 1978**

Roy A Renner Nov 1978 85 p refs

(Contract DOT-HS-7-01790)

(PB-293940/3, DOT-HS-803-880)

Avail NTIS HC A05/MF A01 CSCL 21G

Eleven different advanced automobile engine types were examined as to the possibilities for introduction prior to 1990. An assessment was made based on extensive literature survey and extrapolation of learning curves toward future values of fuel economy and emissions. Gas turbines and external combustion engines are unlikely to be in general use prior to 1990. Stratified charge engine, the advanced diesel, and internal combustion engines with variable displacement features were considered to be likely candidates for use prior to 1990. These engines were analyzed and learning curves were determined for fuel economy predictions with exhaust emission constraints  
GRA

**N79-28652#** Department of Energy, Washington, D C Energy Information Administration

**FACTORS AFFECTING THE DECLINE RATE OF OLD OIL PRODUCTION**

Charles G Everett Dec 1978 27 p refs

(DOE/EIA-0102/29) Avail NTIS HC A03/MF A01

Data on old oil production over the period January 1975 to March 1978 were analyzed. It is concluded that the rapid decline in reported values of Lower Tier Oil was effected by changes in the regulatory definition of Lower Tier Oil in addition to the normal decline which would have obtained under regulatory stability. By analyzing the available data the old portion of old/new properties is projected to decline at about 5.5 percent per year. If projections from the two subcategories are combined the average annual decline between 1978 and 1985 is approximately 9.1 percent, and the 1985 forecast of Lower Tier Oil production is about 1.8 million barrels per day  
DOE

**N79-28653#** California Univ, Livermore Lawrence Livermore Lab

**REACTION KINETICS FOR REMODELING OIL SHALE RETORTING**

J H Campbell and A K Burnham Jan 1979 51 p refs Presented at the Am Inst of Chem Eng Meeting, Houston, Tex, 1-5 Apr 1979

(Contract W-7405-eng-48)

(UCRL-81622, Conf-790405-8)

Avail

NTIS

HC A04/MF A01

Results from recent laboratory kinetic studies on gasification, pyrolysis, and mineral reactions in oil shale are presented. The specific pyrolysis reactions investigated include the decomposition of kerogen, the evolution of oil, hydrogen and C<sub>2</sub> plus C<sub>3</sub> hydrocarbons and the formation of a carbonaceous residue. Data describing the evolution of H<sub>2</sub> and CH<sub>4</sub> during secondary pyrolysis of the carbonaceous residue are also presented. The mineral reaction kinetics discussed include the decomposition and/or reaction (with silica or silicates) of calcite, dolomite, dawsonite and nahcolite. Rate equations describing the effects of CO<sub>2</sub> and steam on the reactions of calcite and dolomite are presented. Kinetics describing gasification of the carbonaceous residue by CO<sub>2</sub> and H<sub>2</sub>O are examined. DOE

**N79-28654#** Lewin and Associates Inc. Washington D C  
**ENHANCED RECOVERY OF UNCONVENTIONAL GAS THE METHODOLOGY, VOLUME 3**

Vello A. Kuuskraa, J. P. Brashear, Todd M. Doscher (University of Southern California), and Lloyd E. Elkins. Feb 1979. 407 p. refs. 3 Vol.

(Contract EF-77-C-01-2705)

(HCP/T-2705-03) Avail NTIS HC A18/MF A01

The methodology is described on the analytic approach, estimated natural gas production, recovery from tight gas sands, recovery from Devonian shales, recovery from coal seams and recovery from geopressured aquifers. Author (DOE)

**N79-28655#** Golder Associates, Inc., Kirkland, Wash  
**PLAN TO DEMONSTRATE OIL SHALE MINING AND RUBBLIZING FOR A MODIFIED IN SITU RETORTING PROCESS**

Jan 1979. 50 p.

(Contract W-7405-eng-48)

(UCRL-13979) Avail NTIS HC A03/MF A01

A proposed program for investigating the mining and rubblizing requirements for modified in-situ retorting is reported. The program includes basic blasting experiments in small scale retorts and is scoped in some detail with schedules and costs estimated fairly reliably. The program also includes application of the results obtained to a larger scale to test the mining concepts and the success of rubblization in a commercial size retort. This work is necessarily described in less detail and only approximate time and cost estimates are provided. DOE

**N79-28656#** California Univ., Livermore. Lawrence Livermore Lab

**MULTIPHASE FLOW ANALYSIS OF OIL SHALE RETORTING**

D. Gidaszow (Illinois Inst. of Tech., Chicago) and R. W. Lyczkowski. Mar 1979. 16 p. refs. Presented at 2d Multiphase Flow and Heat Transfer Symp. and Workshop, Miami Beach, Fla., 16-18 Apr 1979.

(Contract W-7405-eng-48)

(UCRL-81717-Rev-1, Conf-790423-4) Avail NTIS HC A02/MF A01

Multiphase processes associated with oil shale retorting were analyzed including condensation of oil shale vapor, and pressure oscillations in oil shale blocks through cracked bedding planes. Energy conservation equations for oil shale retorting, which include the effects associated with condensation of oil, were derived on the basis of two-phase flow theory. It is suggested that an effective heat capacity associated with the latent heat of condensation should be included in the modeling of simulated modified in-situ oil shale retorting. A pressure propagation equation for fast transients in oil shale cracks was derived and examined in view of existing experimental data. For slow processes a limiting solution for maximum pressure in oil shale rocks was obtained. DOE

**N79-28657#** California Univ., Livermore. Lawrence Livermore Lab

**CHALLENGE OF EFFICIENTLY RETORTING VERY NONUNIFORM BEDS OF OIL SHALE RUBBLE**

T. R. Galloway. 16 Mar 1979. 74 p. refs. Presented at AIChE Meeting, Houston, Tex., 1-5 Apr 1979.

(Contract W-7405-eng-48)

(UCRL-81721-Rev-1, Conf-790405-9)

Avail

NTIS

HC A04/MF A01

Recent experimental pilot scale retort work has shown significant declines in oil recovery yield as the size of the shale block increases. Current analyses of the problem were reviewed together with experimental evidence for the key fluid mechanical, heat transfer and mass transfer processes that caused these lower yields. It was found that loss in retort oil yield was dominated by the flow patterns in the matrix material around the large blocks and by the thermal transient characteristics within the blocks. The principal mechanism appeared to be burning and cracking of the produced oil in the gas phase near the larger shale blocks. The use of process control methods involving air/steam ratio, total flow, and flow variations coupled with monitored exit gas composition appears feasible to maximize oil production. DOE

**N79-28658#** California Univ., Livermore. Lawrence Livermore Lab

**MULTIPHASE FLOW ANALYSIS OF OIL SHALE RETORTING**

D. Gidaszow and R. W. Lyczkowski. Sep 1978. 22 p. refs. Presented at 2d Multiphase Flow and Heat Transfer Symp. Workshop, Miami Beach, Fla., 16 Apr 1979.

(Contract W-7405-eng-48)

(UCRL-81717, Conf-790423-2)

Avail

NTIS

HC A02/MF A01

Several multiphase phenomena occur during oil shale retorting. An analysis is presented of two of these processes including condensation of oil shale vapor and oscillations of pressure in oil shale blocks through cracked bedding planes. Energy conservation equations for oil shale retorting, which include the effects associated with condensation of oil, are derived on the basis of two phase flow theory. It is suggested that an effective heat capacity associated with the latent heat of condensation should be included in the modeling of simulated modified in situ oil shale retorting. A pressure propagation equation for fast transients in oil shale cracks has been derived and examined in view of existing experimental data. For slow processes, a limiting solution for maximum pressure in oil shale rocks has been obtained. Generation of high pressures in rocks by thermal or other means may lead to rock fracture which may be taken advantage of in modified in situ oil shale processing. DOE

**N79-28665** California Univ., Berkeley

**SOLAR ENERGY FIXATION AND CONVERSION WITH ALGAL BACTERIAL SYSTEMS** Ph.D. Thesis

Moshe Uziel. 1978. 234 p.

Avail. Univ. Microfilms. Order No. 7914797

Research on methane fermentation of algae as part of an integrated biological process of solar energy fixation and conversion to natural gas along with purification of waste water is described. The research was initiated since there is a need for alternative energy sources and methods for pollution control. The process involves growth of algae and bacteria on waste water, harvesting of algae, methane fermentation of algae and use of the product of fermentation and combustion for additional algae growth. Defined growth media and conditions for growth of this algae are described, as are anaerobic fermentation chemostats and analytical procedures for measurement and analysis of fermentation gases, fatty acids and other chemical parameters. Comparative fermentability of the six species of algae were studied. Dissert. Abstr.

**N79-28667#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**SOLAR TRACKING SYSTEM** Patent Application

Paul R. White and Donald R. Scott, inventors (to NASA). Filed 25 Feb 1979. 16 p.

(NASA-Case-MFS-23999-1 US-Patent-Appl-SN-060435) Avail NTIS HC A02/MF A01 CSCL 10A

A solar collector is angularly oriented by motor wherein the output of two side-by-side photodetectors are discriminated as



to three ranges corresponding to a low light or darkness condition by east control circuit to light intensity lying in an intermediate range by pointing control circuit, and to light above an intermediate range, direct sunlight, by differential tracking circuit. The first output drives the motor to a selected maximum easterly angular position to await sunrise, the second enables the motor to be driven westerly at the earth rotational rate when clouds are present which prevent accurate tracking, and the third output, actually the separate outputs of the two photodetectors, differentially controls the direction of rotation of motor through east drive relay and west drive relay to effect tracking of the sun  
NASA

**N79-28668#** California Univ., Livermore Lawrence Livermore Lab

**PROGRAM REPORT FOR FY 1978. ATMOSPHERIC AND GEOPHYSICAL SCIENCES DIVISION OF THE PHYSICS DEPARTMENT**

J B Knox, ed and R C Orphan, ed Dec 1978 75 p refs Sponsored by DOE  
(UCRL-51444-78) Avail NTIS HC A04/MF A01

The environmental issues addressed by G Division research, the technical objectives of the program, and the highlights of program accomplishments in FY-1978 are presented. A summary of G Division's numerical modeling capabilities is given, as well as an annotated bibliography of the division's publications in the atmospheric sciences during FY-1978. Supplementary material on budget and staffing is included  
M M M

**N79-28670\*#** National Aeronautics and Space Administration, Washington, D C

**FUTURE THRUSTS OF THE NASA SPACE POWER PROGRAM**

Lee Holcomb /in NASA Goddard Space Flight Center 11th Ann Battery Workshop 1978 p 5-16

Avail NTIS HC A23/MF A01 CSCL 10C

General objectives and plan directions are given for current program support in the following areas: (1) solar cells and arrays, (2) batteries and fuel cells, (3) thermoelectric, thermionic, and Brayton cycle conversion systems, (4) circuits and subsystems for the management and distribution of power, and (5) the interactions of the environment with the power system and the spacecraft. Particular emphasis is given to the electrochemical energy conversion storage portion of the program where efforts are directed to improving the energy density and life of nickel cadmium batteries, to validating flight-weight silver hydrogen cells, to promoting the safe use of lithium primary batteries, to completing the silver zinc batteries and the orbital transfer fuel cell technology, to increasing the capacity of space batteries, to and to evaluating new electrochemical concepts for very high energy density. The use of the fuel cell electrolyzer concept for energy storage in both the dedicated and the truly regenerative mode is also being investigated  
A R H

**N79-28674\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md  
**CELL DESIGN AND MANUFACTURING CHANGES DURING THE PAST DECADE**

David Baer /in its 11th Ann Battery Workshop 1978 p 49-56

Avail NTIS HC A23/MF A01 CSCL 10C

Eight of the most important changes that occurred in the GE 12 AH cell over the past ten years, which are currently being used are evaluated, and a systematic approach to compare their relative merits is presented. Typical positive thickness, typical negative thickness, positive loading, negative loading, final KOH quantity, and precharge as adjustment are shown for the control cell, and the following variables: Teflon treatment, silver treatment, light loading, no PQ treatment, polypropylene separator, the A K 1968 plate design no PQ, old elec process, no decarb process and the A K 1968 plate design, no PQ, present aerospace processes. The acceptance test cell voltage and cell pressure performance and capacity test results are included  
A R H

**N79-28709\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**NASA'S LITHIUM CELL TECHNOLOGY PROGRAM**  
Gordon L Juvinal /in NASA Goddard Space Flight Center 11th Ann Battery Workshop 1978 p 431-440

Avail NTIS HC A23/MF A01 CSCL 10C

Briefly outlined are the activities of the various research centers involved in the NASA program. Graphs are presented for (1) the initial results on SOCl<sub>2</sub> decomposition rate, (2) effect of rate on output of Li-SOCl<sub>2</sub> cells, (3) comparison of high and low rate Li-SOCl<sub>2</sub> cells, and (4) effect of temperature on output of Li-SOCl<sub>2</sub> cells. Abusive test results and a description of secondary lithium cells are also presented  
G Y

**N79-28718\*#** Honeywell, Inc., Morsham, Pa

**APPLICATIONS AND SAFETY DATA**

N J Berlangieri /in NASA Goddard Space Flight Center 11th Ann Battery Workshop 1978 p 511-530

Avail NTIS HC A23/MF A01 CSCL 10C

A general overview of activities involving lithium batteries, which shows the various applications and data that were performed for numerous industry and government sponsors is presented. Brief discussions on electrochemical criteria selection, and typical storage and performance data obtained from three systems being developed are presented. Current safety work being done on high-rate, D, SO<sub>2</sub> cells is also discussed. Three chemistries were developed and are discussed: lithium vanadium pentoxide, lithium sulfur dioxide, and lithium thionyl chloride. Storage, performance and safety data are graphically presented  
G Y

**N79-28721\*#** Engineering Olympic Corp., Richland, Wash  
**SOLAR HEATING, COOLING, AND HOT WATER SYSTEMS INSTALLED AT RICHLAND, WASHINGTON Final Report**  
Jun 1979 258 p Sponsored by NASA  
(Contract EX-76-C-01-2404)

(NASA-CR-161237, OEC-ER-014) Avail NTIS  
HC A12/MF A01 CSCL 10A

The project described is part of the U S Department of Energy's solar demonstration program, and became operational in April 1978. The solar system uses 6,000 square feet of flat-plate liquid collectors in a closed loop to deliver solar energy through a liquid-liquid heat exchanger to the building heat-pump duct work or 9,000-gallon thermal energy storage tank. A 25-ton Arkia solar-driven absorption chiller provides the cooling, in conjunction with a 2,000 gallon chilled water storage tank and reflective ponds on three sides of the building surplus heat. A near-by building is essentially identical except for having conventional heat-pump heating and cooling, and can serve as an experimental control. An on-going public relations program was provided from the beginning of the program, and resulted in numerous visitors and tour groups  
M M M

**N79-28722\*#** Westinghouse Research and Development Center Pittsburgh, Pa

**SILICON WEB PROCESS DEVELOPMENT Annual Report, Apr. 1978 - Apr. 1979**

C S Duncan, R H Hopkins, R G Seidensticker, J P McHugh, F E Hill, M E Heimlich, and J M Driggers Apr 1979 233 p refs Sponsored by NASA Prepared for DOE and JPL  
(Contract JPL-954654)

(NASA-CR-158852, DOE/JPL-954654-79/7) Avail NTIS  
HC A11/MF A01 CSCL 10A

Silicon dendritic web, a single crystal ribbon shaped during growth by crystallographic forces and surface tension (rather than dies), is a highly promising base material for efficient low cost solar cells. The form of the product smooth, flexible strips 100 to 200 microns thick, conserves expensive silicon and facilitates automation of crystal growth and the subsequent manufacturing of solar cells. These characteristics coupled with the highest demonstrated ribbon solar cell efficiency-15.5%-make silicon web a leading candidate to achieve or better the 1986 Low Cost Solar Array (LSA) Project cost objective of 50 cents per peak watt of photovoltaic output power. The main objective of the Web Program technology development to significantly increase

web output rate and to show the feasibility for simultaneous melt replenishment and growth have largely been accomplished. Recently web output rates of 23.6 sq cm/min nearly three times the 8 sq cm/min maximum rate of a year ago were achieved. Webs 4 cm wide or greater were grown on a number of occasions. F O S

**N79-28725\*** # National Aeronautics and Space Administration  
Lewis Research Center Cleveland, Ohio

**SAFETY CONSIDERATIONS IN THE DESIGN AND OPERATION OF LARGE WIND TURBINES Final Report**

Dwight H. Reilly Jun 1979 38 p refs Sponsored in part by DOE

(Contract DE-AI01-79ET20305)

(NASA-TM-79193 E-067, DOE/NASA/20305-79/3) Avail  
NTIS HC A03/MF A01 CSCL 10B

The engineering and safety techniques used to assure the reliable and safe operation of large wind turbine generators utilizing the Mod 2 Wind Turbine System Program as an example is described. The techniques involve a careful definition of the wind turbine's natural and operating environments, use of proven structural design criteria and analysis techniques, an evaluation of potential failure modes and hazards, and use of a fail safe and redundant component engineering philosophy. The role of an effective quality assurance program, tailored to specific hardware criticality, and the checkout and validation program developed to assure system integrity are described. Author

**N79-28726\*** # National Aeronautics and Space Administration  
Lewis Research Center Cleveland, Ohio

**STIRLING ENGINES FOR AUTOMOBILES**

Donald G. Beremand 1979 15 p refs Proposed for presentation at Intern Conf on Energy Use Management Los Angeles, Calif., 22-26 Oct 1979 Sponsored in part by DOE

(Contract EC-77-A-31-1040)

(NASA-TM-79222 E-116) Avail NTIS HC A02/MF A01 CSCL 10B

The results of recent and ongoing automobile Stirling engine development efforts are reviewed and technology status and requirements are identified. Key technology needs include those for low cost high temperature (1300 - 1500 F) metal alloys for heater heads, and reliable long-life low-leakage shaft seals. Various fuel economy projections for Stirling powered automobiles are reviewed and assessed. Author

**N79-28727\*** # National Aeronautics and Space Administration  
Lewis Research Center Cleveland Ohio

**DESIGN, FABRICATION, AND INITIAL TEST OF A FIXTURE FOR REDUCING THE NATURAL FREQUENCY OF THE MOD-O WIND TURBINE TOWER**

J. R. Winemiller, T. L. Sullivan, R. L. Sizemore, and S. T. Yee Jul 1979 21 p Prepared for DOE

(Contract EX-76-I-01-1028)

(NASA-TM-79200, C-081 DOE/NASA/1028 79/24) Avail  
NTIS HC A02/MF A01 CSCL 10B

It was desired to observe the behavior of a two bladed wind turbine where the tower first bending natural frequency is less than twice the rotor speed. The system then passes through resonance when accelerating to operating speed. The frequency of the original Mod-O tower was reduced by placing it on a spring fixture. The fixture is adjustable to provide a range of tower bending frequencies. Fixture design details are given and behavior during initial operation is described. Author

**N79-28728\*** # National Aeronautics and Space Administration  
Lewis Research Center Cleveland, Ohio

**EFFECT OF POSITIVE PULSE CHARGE WAVEFORMS ON CYCLE LIFE OF NICKEL-ZINC CELLS Final Report**

John J. Smithnick Jul 1979 14 p refs Sponsored in part by DOE

(Contract EC-77-A-31-1044)

(NASA-TM-79215 E-100, DOE/NASA/1044-79/3) Avail  
NTIS HC A02/MF A01 CSCL 10C

Five amp-hour nickel-zinc cells were life cycled to evaluate four different charge methods. Three of the four waveforms investigated were 120 Hz full wave rectified sinusoidal (FWRS), 120 Hz silicon controlled rectified (SCR), and 1 kHz square

wave (SW). The fourth, a constant current method, was used as a baseline of comparison. Three sealed Ni-Zn cells connected in series were cycled. Each series string was charged at an average C/20 rate and discharged at a C/2.5 rate to a 75% rated depth. Author

**N79-28729\*** # Garden State Racing Association Cherry Hill N J

**SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT CHERRY HILL, NEW JERSEY**

16 May 1979 299 p Sponsored by NASA

(Contract EG-77-A-01-4086)

(NASA-CR-161235) Avail NTIS HC A11/MF A01 CSCL 10A

The solar heating and hot water system installed in existing buildings at the Cherry Hill Inn in Cherry Hill, New Jersey is described in detail. The system is expected to furnish 31.5% of the overall heating load and 29.8% of the hot water load. The collectors are liquid evacuated tube type. The storage system is an above ground insulated steel water tank with a capacity of 7,500 gallons. R E S

**N79-28732\*** # Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

**COMBINED CYCLES FOR POWER GENERATION, VOLUME 1**

1978 306 p refs Proc of Lectures held at Rhode-Saint-Genese Belgium 2 Vol

(VKI-Lec-Ser-1978-6-Vol-1) Avail NTIS HC A14/MF A01

Papers included in this lecture series refer to closed cycle gas-turbine steam engines, possibilities of combined cycles, combined gas-steam steam turbine power plants with supplementary firing, and the GT/ST cycle in coal gasification.

**N79-28736\*** # Kraftwerk Union A G Reaktortechnik, Erlangen (West Germany)

**COMBINED GAS/STEAM TURBINE POWER PLANTS WITH SUPPLEMENTARY FIRING**

J. Charlier and H. Brueckner In Von Karman Inst for Fluid Dyn Combined Cycles for Power Generation Vol 1 1978 59 p refs

Avail NTIS HC A14/MF A01

Combined cycles systems are analyzed, especially those in the high power range. A coal and natural gas fired combined cycles power plant with a 750 MW output is described. Most of the power is produced by the steam turbine arrangement in which additional firing is involved. An efficiency on the order of 40 percent to 42 percent is obtained. Further applications of combined cycles and new developments in Germany are discussed. Author (ESA)

**N79-28737\*** # Sulzer Bros Ltd Winterthur (Switzerland)

**THE GAS TURBINE/STEAM TURBINE CYCLE WITH COAL GASIFICATION**

A. Steiner In Von Karman Inst for Fluid Dyn Combined Cycles for Power Generation, Vol 1 1978 43 p refs

Avail NTIS HC A14/MF A01

Available processes for solid fuel gasification and subsequent gas desulfuration are described as they are especially suitable GT/ST cycles. Economic arguments and environmental protection regulations are discussed. Coal gasification is analyzed both as fixed bed generators and fluid bed generators. Purification alternatives such as physical washing, chemical washing, physical-chemical washing, and absorption are described. A 170 MW coal gasification combined power plant located at Luner, Germany, is described as an example. A Westinghouse combined cycle plant with 'U-gas fluidized-bed gasification is also discussed. Author (ESA)

**N79-28738\*** # Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)

**COMBINED CYCLES FOR POWER GENERATION**

1978 318 p refs Lecture held at Rhode-Saint-Genese, Belgium  
24-28 Apr. 1978 2 Vol

(VKI-Lec-Ser-1978-6-Vol-2) Avail NTIS HC A14/MF A01  
Subjects discussed include recuperative gas cycles with  
derivation for power and heat generation, power generation power  
generation with binary cycles, magnetohydrodynamics, and  
thermoionic conversion

**N79-28739#** Commissariat a l'Energie Atomique, Saclay (France)  
**RECUPERATIVE GAS CYCLES WITH DERIVATION FOR  
POWER AND HEAT GENERATION APPLICATION TO  
COMBINED CYCLES**

Z P Tilliette /in Von Karman Inst for Fluid Dyn Combined  
Cycles for Power Generation, Vol 2 1978 43 p

Avail NTIS HC A14/MF A01

Recuperative gas cycles without a by-pass steam generator  
are briefly reviewed. Recuperative cycles with a by-pass steam  
generator are discussed along with many charts and diagrams.  
The main advantages include high overall plant efficiency  
especially for electrical generation when using combined  
gas-steam cycles, favorable technological conditions for steam  
generation, and good operational flexibility. Three examples of  
conditions and performances are presented corresponding to the  
open cycle, the fossil fuel case and to the closed cycle with  
helium as the working fluid in the fossil fuel case as well as  
the nuclear fuel case. Author (ESA)

**N79-28740#** Mechanical Technology, Inc., Latham, N Y  
**POWER GENERATION WITH BINARY CYCLES**

D D Colosimo, R K Rose, and O Decker /in Von Karman  
Inst for Fluid Dyn Combined Cycles for Power Generation,  
Vol 2 1978 196 p refs

Avail NTIS HC A14/MF A01

The state of the art in Rankine bottoming cycles is surveyed  
in order to illustrate the applicability of binary cycles. Selection  
of Rankine cycle working fluids is discussed referring to six  
available commercial products. The two favorite industrial waste  
heat sources, gas turbines and diesel engines, are reviewed in  
reference to applicability to steam organic or binary cycles. Effects  
of governmental policies and alternative energy prices on the  
economics of energy recovery are discussed. Criteria for screening  
organic and binary cycle adaptation to industrial processes are  
given. Author (ESA)

**N79-28741#** Massachusetts Inst of Tech, Cambridge  
**MAGNETOHYDRODYNAMICS**

Jean F Louis /in Von Karman Inst for Fluid Dyn Combined  
Cycles for Power Generation, Vol 2 1978 64 p refs

Avail NTIS HC A14/MF A01

Magnetohydrodynamic theory, application schemes, and an  
economic analysis are surveyed. A typical example of an open  
cycle direct preheat MHD-steam plant project is discussed. A  
nominal output power of 2000 MW, 7 years construction time,  
an overall net efficiency of 48 percent, and other parameters  
are detailed. The case of oxygen enrichment and the closed  
cycle inert gas MHD are briefly discussed. Author (ESA)

**N79-28742#** Massachusetts Inst of Tech, Cambridge  
**THERMIONIC CONVERSION**

Jean F Louis /in Von Karman Inst for Fluid Dyn Combined  
Cycles for Power Generation, Vol 2 1974 15 p

Avail NTIS HC A14/MF A01

The state of the art of thermionic conversion is surveyed. It  
is anticipated that in the next 10 years the goal of reducing the  
barrier index to about 1 to 1.6 electron-volts will be reached  
permitting a number of practical applications such as topping  
units for steam power plants. A 1000 MW joint General Electric  
and Thermo Electron Corporation project is discussed. Pulverized  
coal is used as fuel, with steps of thermionic conversion  
complemented by steam turbogenerators. Overall efficiency is  
46.7 percent. Author (ESA)

**N79-28743#** TRW Defense and Space Systems Group, Redondo  
Beach, Calif

**ENERGY RECOVERY FROM ARMY AMMUNITION PLANT  
SOLID WASTE BY PYROLYSIS Final Report**

J D Pinkerton, R F Tobias and Robert Scola Mar 1979  
85 p refs

(Contract DAAA21-76-C-0537)  
(AD-A067519 AD-E400300 ARLCD-CR-78030) Avail NTIS  
HC A05/MF A01 CSCL 13/2

Army Ammunition Plants (AAPs) dispose of large quantities  
of solid waste by incineration, open-air burning, and landfill. There  
is at present no attempt at energy recovery. The present study  
was conducted to determine the feasibility of adapting pyrolysis  
technology for energy recovery from these solid wastes. Eight  
AAPs were surveyed to identify the types and amounts of solid  
waste generated. Candidate systems were evaluated to determine  
their suitability for this application. Safety considerations indicate  
that propellants, explosives, and pyrotechnics (PEP) and PEP-  
contaminated waste with proper precautions could be handled  
safely by pyrolysis processes, but further work is needed to  
determine applicable size reduction techniques. It was determined  
that a 45.4 MG/d (50 TPD) plant would be sufficient to handle  
the largest quantity of waste generated at any AAP. Capital  
cost was estimated at \$4.1 million and annual cost at \$623,100.  
Based on these costs, it was concluded that pyrolysis is not  
economically feasible at this time even under mobilization  
conditions. GRA

**N79-28744#** Naval Research Lab., Washington, D C  
**IMPROVEMENTS IN THE LEAD-ACID BATTERY FOR LOAD  
LEVELING APPLICATIONS Interim Report, FY 1978  
Summary Report**

A C Simon, S M Caulder, C P Wales, and R L Jones May  
1979 27 p refs

(AD-A068990, NRL-MR-3988) Avail NTIS  
HC A03/MF A01 CSCL 10/3

This report describes research conducted in FY-78 under a  
DOE program to improve the lead-acid battery system for load  
leveling at electricity-generating plants. The study has identified  
changes in the plate active material that occur during cycling  
(or service operation), viz a progressive buildup of an electrochem-  
ically inactive PbO<sub>2</sub> species and the physical transformation of  
the active material to a structurally unfavorable coralloid form,  
which if eliminated could improve battery performance. GRA

**N79-28747#** California Univ, Berkeley, Lawrence Berkeley  
Lab

**GEOTHERMAL RESOURCE EXPLORATION ASSESSMENT  
AND DATA INTERPRETATION, KLAMATH BASIN, ORE-  
GON SWAN LAKE AND KLAMATH HILLS AREA**

M Stark, N Goldstein, H Wollenberg, B Strisower, and M  
Hege Oct 1978 80 p refs Presented at Klamath Basin  
Geothermal Assessment Steering Comm Meeting, Berkeley, Calif  
9 Nov 1978

(Contract W-7405-eng-48)  
(LBL-8186(Draft) Conf-781190-1) Avail NTIS  
HC A05/MF A01

A synthesis and preliminary interpretation of predominantly  
geophysical information relating to the Klamath Basin geothermal  
resource is presented. The Swan Lake Valley area northeast of  
Klamath Falls and the Klamath Hills area south of Klamath  
Falls, are discussed in detail. Available geophysical data, including  
gravity, magnetic, electrical resistivity, microseismic, moving dipole  
resistivity, audio-magnetotelluric (AMT) and magnetotelluric (MT)  
data sets, are examined and reinterpreted for these areas. One-  
and two-dimensional modeling techniques are applied and general  
agreement among overlapping data sets is achieved. DOE

**N79-28749#** Ocean Systems, Inc., Reston, Va  
**OTEC PLATFORM CONFIGURATION AND INTEGRATION  
STUDY VOLUME 1. SYSTEMS ENGINEERING AND  
INTEGRATION Final Report**

Apr 1978 315 p refs  
(Contract EC-77-C-01-4063)  
(DOE/ET/4063-1-Vol-1, LMSC-D623756-Vol-1) Avail NTIS  
HC A14/MF A01

The economic success of an ocean thermal energy conversion (OTEC) system is highly dependent on a platform which provides adequate support for the power system, accommodates reliably the cold water pipe, and is most cost effective. The results of a study conducted for the Department of Energy to assess six generic types of platforms to determine the most satisfactory platform for several potential sites are presented. The six platform configurations are ship, circular barge, semi-submersible, tuned sphere, submersible and spar. These represent directional and symmetric types of platforms which operate on the surface, at the interface, and submerged. The five sites for this study were primarily New Orleans, Keahole Point (Hawaii), Brazil and secondarily Key West and Puerto Rico. Electrical transmission of energy by submarine cable is the planned form of energy transmission for all sites except Brazil, where chemical conversion is to be the method of transmission. This study is devoted to the platform (or ocean systems) of the OTEC plant which is chiefly comprised of the hull and structure, the seawater system, the position control system and miscellaneous support/assembly systems. The principal elements in the work breakdown structure for the commercial plants are presented. The assessment of the six platform configurations was conducted utilizing a baseline plan (100-MW(e) (Net)) and site (New Orleans) with variations from the baseline to cover the range of interested platforms and sites. DOE

**N79-28750#** Lockheed Missiles and Space Co., Sunnyvale, Calif  
**OTEC PLATFORM CONFIGURATION AND INTEGRATION STUDY. VOLUME 3. PROJECT PLAN. Final Report**  
Apr 1978 15 p ref  
(Contract EC-77-C-01-4063)  
(DOE/ET/4063-1-Vol-3, LMSC-D623756-Vol-3) Avail NTIS HC A02/MF A01

The characteristics which were desired in the demonstration plant are discussed and the demonstration activities for that plant are commented on. The cost, scale, and state of development of the technology the plant employs are covered. DOE

**N79-28751#** Department of Energy, Washington, D C Energy Information Administration  
**HISTORIC AND FORECASTED ENERGY PRICES BY US DEPARTMENT OF ENERGY REGION AND FUEL TYPE FOR THREE MACROECONOMIC SCENARIOS AND ONE IMPORTED OIL PRICE ESCALATION SCENARIO**  
S Borg and R W Moden Dec 1978 38 p ref  
(DOE/EIA-0102/27) Avail NTIS HC A03/MF A01

The Energy Information Administration was requested to provide forecasts of energy prices at the DOE regional level for each year through the year 2000. Historical fuel prices for 1975, and 1976, and forecasted fuel prices for 1985 and 1990 are reported as an initial step in this process. The assumption and the methodology employed are described and results are tabulated. DOE

**N79-28752#** Department of Energy, Washington, D C Energy Information Administration  
**SOLAR ENERGY POTENTIAL FOR RESIDENTIAL WATER HEATING AND SPACE HEATING IN THE 12TH CONGRESSIONAL DISTRICT OF PENNSYLVANIA. ANALYSIS MEMORANDUM**  
R W Moden, P A DonVito, C A Allen, and R D Stoll Dec 1978 20 p refs  
(DOE/EIA-0102/22) Avail NTIS HC A02/MF A01

The analysis reflects local fuel prices anticipated price escalations, climatic conditions (including the level of solar energy), building characteristics and installed solar costs. The results of the analysis indicate that solar systems are not cost competitive with conventional systems available in the District except under special circumstances. Solar systems could become marginally competitive against electric resistance units in the next few years if installed system costs were to become substantially lower than presently anticipated. DOE

**N79-28753#** California Univ., Livermore Lawrence Livermore Lab  
**APPLICATION OF SHALLOW SOLAR PONDS FOR INDUSTRIAL PROCESS HEAT: CASE HISTORIES**

Alan B Casamajor 16 Oct 1978 18 p refs Presented at Symp on Commercialization of Solar and Conservation Technol Miami Beach Fla 11-13 Dec 1978 Submitted for publication (Contract EY-76-C-02-0016)  
(UCRL-81764 Conf-781235-1) Avail NTIS HC A02/MF A01

The shallow-solar-pond collector system is approaching commercialization. Three prototype or demonstration projects are described. A critique of each project points out the significant factors that affect the individual projects and shallow-solar-pond technology in general. Particular attention is drawn to problems encountered and solutions proposed. Possible marketing organization and strategies are discussed. DOE

**N79-28754#** Los Alamos Scientific Lab N Mex  
**TROMBE WALL VS DIRECT GAIN. A COMPARATIVE ANALYSIS OF PASSIVE SOLAR HEATING SYSTEMS**  
William O Wray and J Douglas Balcomb 1979 8 p refs Presented at the 3d Natl Passive Solar Conf., San Jose, Calif 11-13 Jan 1979  
(Contract W-7405-eng-36)  
(LA-UR-116, Conf-790106-2) Avail NTIS HC A02/MF A01

The results of performance analysis calculations for both Trombe wall and direct gain systems in Albuquerque, New Mexico and Madison, Wisconsin, are reported. The comparative analysis included parametric variation of fundamental design parameters including building load, glazing area, total mass, mass thickness, number of glazings, night insulation value and allowable temperature swing. Thermal comfort within the two generic types of buildings was considered as well as energy efficient performance. DOE

**N79-28755#** Los Alamos Scientific Lab N Mex  
**APPLICATIONS OF DOE-1 TO PASSIVE SOLAR HEATING OF COMMERCIAL BUILDINGS. PRELIMINARY RESULTS**  
B D Hunn, N M Schnurr, J L Peterson, J F Kerrisk and J E Moore 1979 6 p refs Presented at the 3d Natl Passive Solar Conf., San Jose, Calif, 11-13 Jan 1979 Submitted for publication  
(Contract W-7405-eng-36)  
(LA-UR-79-72, Conf-790106-6) Avail NTIS HC A02/MF A01

The DOE-1 building energy analysis computer program was modified to include analysis of passive solar and large thermal mass heating and cooling systems. SUNSPOT is a detailed thermal network computer program developed for direct gain systems as a reference analysis tool to compare with the DOE-1. It was validated by comparison of calculated results with experimental test cell data. A series of runs was then made to determine the sensitivity of solar fraction to type of glazing, location and quantity of mass, and method of computing infrared radiant interchange among inside surfaces. Simulations using DOE-1 in its present form indicate that the weighting factors used in the program are not satisfactory for large mass/direct gain systems. However, it does appear that the weighting factor approach can be retained if an efficient method of determining weighting factors appropriate to passive systems can be developed. DOE

**N79-28756#** Los Alamos Scientific Lab N Mex  
**PERFORMANCE AND COST OF A HYBRID PASSIVE/ACTIVE SOLAR HOUSE**  
B D Hunn 1979 26 p refs Presented at the ASHRAE Symp on Air Infiltration Philadelphia Jan 1979  
(Contract W-7405-eng-36)  
(LA-UR-78-2209 Conf-790112-4) Avail NTIS HC A03/MF A01

The design, construction, cost and initial operation of a hybrid passive/active solar heated house in Los Alamos, New Mexico is described. The system is dominated by a two-story Trombe wall, constructed of 0.3 m thick (1 ft) slump block that can be operated in either a passive or active mode. In the active mode, a blower circulates air through the Trombe wall air space and into a rock bed. A three zone forced air distribution system is connected to the rock bed. A separate flat plate collector array heats a preheater tank for domestic hot water. Operating results of the system are reported for just over the first year of operation. In addition, system cost, occupant observations, and conclusions

are presented Energy consumption records indicate that approximately 60% of the net space heating load was provided by solar energy DOE

**N79-28757#** Lincoln Lab Mass Inst of Tech Lexington  
**PHOTOVOLTAIC/THERMAL COLLECTORS AND HEAT PUMPS**

Edward C Kern Jr 1978 14 p refs Presented at Meeting of the Am Sect of the Intern Solar Energy Soc Denver 28 Aug 1978

(Contract EG-77-S-02-4577)

(COO-4577-2, Conf-780808-26)

Avail

NTIS

HC A02/MF A01

A simple solar-heating system comprised of an idealized heat pump and photovoltaic/thermal energy collectors is described and its performance characteristics analyzed The mathematical model expresses the system's heating capacity as a function of insolation ambient air temperature, and thermal-energy storage temperature Using a closed-form solution the system's overall efficiency is presented and compared to the efficiency of a conventional solar heating system DOE

**N79-28762#** Sandia Labs, Albuquerque, N Mex  
**OVERVIEW OF SOLAR SYSTEM DESIGN AND APPLICATION PRINCIPLES**

V L Dugan 1979 11 p refs Presented at the Solar Energy Symp, Tokyo, 5 Feb 1979

(Contract EY-76-C-04-0789)

(SAND-78-2419C, Conf-790203-1)

Avail

NTIS

HC A02/MF A01

Solar thermal energy conversion systems represent a method of reducing dependency on stored energy reserves this is done at the expense of an increased dependency on materials and land resources The various technologies being investigated to convert solar radiation into thermal energy are reviewed and general guidelines which should be followed in designing and applying cost-effective solar conversion systems are presented This information is expanded upon and illustrated by a comparison of performance results for a range of solar thermal technologies and by one solar irrigation application in the United States DOE

**N79-28765#** Northeast Solar Energy Center Cambridge Mass  
**BARRIERS AND INCENTIVES TO SOLAR ENERGY DEVELOPMENT AN ANALYSIS OF LEGAL AND INSTITUTIONAL ISSUES IN THE NORTHEAST**

Arnold R Wallenstein Dec 1978 115 p

(Contract EM-78-C-01-4274)

(NESEC-1) Avail NTIS HC A06/MF A01

The legal and institutional barriers and incentives to commercializing alternate energy sources are analyzed with particular emphasis on solar energy The laws that constitute either legal barriers or possible incentives in the commercializing of solar energy in the nine states served by the Northeast Solar Energy Center are detailed Each barrier or incentive is briefly described in conceptual terms and then each issue area is analyzed in detail, within the context of the law of the nine states in the region An analysis is given of Federal patterns of spending and subsidy The section also addresses life-cycle costing the problem of obtaining loans and insurance DOE patent regulation issues and briefly describes potential Federal and state financial sources for solar energy development Laws in the nine-state region that address product and tort liability, warranty protection consumer credit, consumer protection trade and business regulation statutes and equipment certification and product standards problems are discussed Zoning land use, sun and wind access, and building codes and inspection problems are included Public utility regulations, state energy solar office enabling legislation and labor jurisdiction questions are covered DOE

**N79-28766#** Garrett Energy Research and Engineering Co  
Ojai Calif

**THERMOCHEMICAL CONVERSION BIOMASS GASIFICATION**

D E Garrett 1978 16 p refs

(Contract EY-76-C-03-1241)

(TID-29391) Avail NTIS HC A02/MF A01

The thermal conversion of biomass into medium Btu gas is being studied in process development units of the multiple hearth type The operation of the PDU is described and a process description is given Significant findings with respect to the steam-carbon reaction rates stability of the hydrocarbon gases and direct contact drying of manure are summarized DOE

**N79-28768#** Sandia Labs Albuquerque N Mex  
**INSOLATION MODELING OVERVIEW**

E C Boes Dec 1978 18 p refs

(Contract EX-76-C-04-0789)

(SAND-78-0963) Avail NTIS HC A02/MF A01

Some of the major national projects in the solar radiation resource assessment area are summarized Historical SOLMET solar data tapes are described, including the solar radiation models used in their development Recommendations for appropriate data sources for solar system simulations are given DOE

**N79-28769#** Lincoln Lab Mass Inst of Tech Lexington  
**ECONOMICS OF SOLAR PHOTOVOLTAIC ENERGY SYSTEMS FOR CROP IRRIGATION IN THE UNITED STATES**

R W Matlin and M T Katzman (Texas Univ at Dallas Richardson)

1978 12 p refs Presented at the Atelier Pompage Solaire Perpignan France 3 Jul 1978

(Contract EY-76-C-02-4094)

(COO-4094-29 Conf-780773-2)

Avail

NTIS

HC A02/MF A01

In the United States the majority of the energy for pumping water is used over extremely large areas (160-acre quarter sections), requiring large pumping units (100 to 300 kW peak power) Additionally the American farmer has traditionally had access to low-cost energy An economic analysis of the profitability of adopting solar photovoltaic energy systems for such situations was undertaken The basis for this analysis is presented along with a discussion as to the time of initial profitability the time of optimal investment the effects of the tax system, the cost per acre that would make irrigation inviable, and possible governmental incentives that would promote the deployment of photovoltaic irrigation systems between the time of initial profitability and the time of optimal investment DOE

**N79-28770#** Texas Univ at Austin Center for Energy Studies

**TESTING AND SAMPLING PROCEDURES FOR GEOTHERMAL-COMPRESSED WELLS Final Report**

W E Boyd [1978] 155 p

(Contract EY-76-S-05-5243)

(UT/CES-GR-2) Avail NTIS HC A08/MF A01

Test wells to tap and sample geothermal-geopressured formations at 15,000 to 20,000 feet in the Gulf Coast area can be drilled routinely utilizing available equipment and methods Electrical logs surveys and fluid samplers can be used to obtain accurate and reliable information as to depths temperatures pressures and fluid content of the geopressured formations before the well is completed But it will be necessary to set casing and flow the well, at least temporarily to secure fluid production volume and pressure data to evaluate the producibility of the geopressured resource Electric logging and wireline survey methods are fully developed techniques for measuring the parameters needed to assess a geopressured zone before setting casing Formation subsidence though it may be slow to develop can be measured during radioactivity tracer surveys The following conclusions are drawn existing well logging and surveying methods and equipment are generally satisfactory for testing and sampling a geothermal-geopressured resource no significant areas of research are needed to predict, detect, and evaluate geopressured formations for their potential as geothermal resources Static and dynamic testing procedures using existing technology are satisfactory to test sample and analyze a geopressured reservoir DOE

**N79-28771#** Department of Energy, Washington, D C Div of Solar Applications Developments

**SOLAR HEATING AND COOLING DEMONSTRATION PROJECT SUMMARIES**

Jan 1979 319 p refs

(DOE/CS-0038-2) Avail NTIS HC A14/MF A01

The demonstration program includes commercial and residential-type buildings sponsored by DOE alone, or jointly with other Federal agencies, city and state governments, and private agencies. The commercial projects include a wide variety of building types, such as office buildings, schools, fire stations, civic centers, factories, and libraries. Residential projects include both single and multifamily dwellings of various configurations. Approximately 200 projects will be instrumented to measure the performance of the solar systems. Analysis of the collected data will provide definitive guides for design criteria and permit realistic economic assessment of various solar systems. The demonstrations are discussed in three sections: commercial demonstration program-non-federal buildings, commercial demonstration program-federal buildings, and residential demonstration program-federal buildings. Maps showing the locations (by state) of the buildings are provided at the beginning of each section along with an index that identifies each project and page number for the corresponding descriptive information. A map depicting the distribution of all demonstration projects is included in this introduction. The comparable map from last year's publication is also shown to depict the increase in the number of projects. The contents of this document are based on information available as of November 1, 1978. DOE

**N79-28772#** Radian Corp., Austin, Tex

**MATERIALS SELECTION GUIDELINES FOR GEOTHERMAL POWER SYSTEMS, FIRST EDITION**

David W. DeBerry, Peter F. Ellis, and Colin C. Thomas Sep 1978 319 p refs

(Contract EG-77-C-04-3904)

(ALO-3904-1 DCN-78-200-181-17) Avail NTIS HC A14/MF A01

Nine potential power cycles are defined and diagrammed for the generation of electricity from geothermal fluids. General fluid properties that influence the applicability of power cycles to a particular geothermal resource are discussed. The corrosivity of individual process streams in power cycles is described based on variation in chemical composition and temperature. Results of materials performance tests are analyzed based on the chemical composition of the corrosive medium and physical factors such as temperature, duration of exposure, and fluid velocity. The key chemical components in geothermal fluids that are significant in determining corrosivity are identified. Both summarized and detailed results of materials performance tests in US liquid-dominated resources are given. Seven US liquid-dominated KGRA's are classified according to relative corrosiveness and their key chemical components are defined. The various forms and mechanisms of corrosive attack that can occur in geothermal process streams are described. The application of nonmetallic materials in geothermal environments is reported. DOE

**N79-28773#** Los Alamos Scientific Lab., N Mex

**ELECTRICITY FROM HOT DRY ROCK GEOTHERMAL ENERGY: TECHNICAL AND ECONOMIC ISSUES**

Jefferson W. Tester, Glenn E. Morris, Ronald G. Cummings (N Mex Univ., Albuquerque), and Robert L. Bivins Jan 1979 27 p refs

(Contract W-7405-eng-36)

(LA-7603-MS) Avail NTIS HC A03/MF A01

Extraction of energy from hot dry rock would make available a nearly unlimited energy source. Some of the technical problems and possible economic tradeoffs involved in a power generating system are examined and possible solutions proposed. An intertemporal optimization computer model of electricity production from a hot dry rock geothermal source has been constructed. The effects of reservoir degradation, variable fluid flow rate, and drilling operations are examined to determine optimal strategies for reservoir management and necessary conditions for economic feasibility. DOE

**N79-28774#** California Univ., Livermore Lawrence Livermore Lab

**DESIGN GUIDE FOR SHALLOW SOLAR PONDS**

A. B. Casamajor and R. E. Parsons 8 Jan 1979 65 p refs

Revised

(Contract W-7405-eng-48)

(UCRL-52385-Rev-1) Avail NTIS HC A04/MF A01

The three aspects of Shallow Solar Ponds (SSP) technology discussed include (1) an introduction to SSP technology, potential, and limitations, (2) a description of the design and operation of an SSP system including component drawings and specifications, and (3) planning information so that an SSP system can be sized for particular application and the cost can be estimated. DOE

**N79-28775#** Oak Ridge National Lab., Tenn

**GAS-STEAM TURBINE COMBINED CYCLE POWER PLANTS**

Jeffrey E. Christian Oct 1978 68 p refs

(Contract W-31-109-eng-38)

(ANL/CES/TE-78-4) Avail NTIS HC A04/MF A01

Performance and cost characteristics of the combined gas and steam turbine cycle system applied to an integrated Community Energy System (ICES) are given. The basic gas-steam turbine combined cycle consists of (1) a gas turbine-generator set, (2) a waste-heat recovery boiler in the gas turbine exhaust stream designed to produce steam, and (3) a steam turbine acting as a bottoming cycle. Because modification of the standard steam portion of the combined cycle would be necessary to recover waste heat at a useful temperature some sacrifice in the potential conversion efficiency is necessary at this temperature. The total energy efficiency varies from about 65 to 73 percent at full load to 34 to 49 percent at 20 percent rated electric power output. Two major factors considered when installing a gas-steam turbine combined cycle are the reliability of the gas turbine portion of the cycle, and the availability of liquid and gas fuels or the feasibility of hooking up with a coal gasification/liquefaction process. DOE

**N79-28776#** Oak Ridge National Lab., Tenn Engineering Technology Div

**COMPARATIVE EVALUATION OF RECENT REPORTS ON THE ENERGY CONSERVATION POTENTIAL FROM COGENERATION**

R. W. Barnes (Dow Chemical USA, Midland, Mich) and O. H. Klepper Feb 1979 48 p refs

(Contract W-7405-eng-26)

(ORNL/TM-6602) Avail NTIS HC A03/MF A01

Most of the electricity generated in the US and the heat used by industry, buildings, and homes are produced independently from the combustion of separate fuels. Cogeneration, the combined production of electricity and useful heat, could reduce significantly the total amount of fuel required. This report discusses areas of application and alternative technologies for cogeneration. Projections by various investigators indicate potential US energy savings from 1 to 2 percent up to almost 10 percent. Several of the published estimates of potential energy conservation benefits from cogeneration are analyzed and reduced to common bases for comparison. Significant differences in the various projections arise from differences in estimating the size of the industrial steam demand and from divergent assumptions concerning the tractability of various implementation problems. DOE

**N79-28777#** Argonne National Lab., Ill Energy and Environmental Systems Div

**COST STUDY APPLICATION OF THE GUIDEBOOK ON INTEGRATED COMMUNITY ENERGY SYSTEMS INDIRECT ECONOMIC AND ENERGY IMPACTS**

Nov 1978 31 p

(Contract W-31-109-eng-38)

(ANL/ICES-TM-17) Avail NTIS HC A03/MF A01

An integrated community energy system (ICES) was considered for a community located in a small New England city. The ICES involves substitution of energy forms as well as modification of fuel requirements. Examination of the integrated

system, in comparison with existing energy systems, includes both indirect economic impacts (employment and fiscal effects on the city) and indirect energy impacts. The indirect economic analysis proceeds from an initial description of conditions that determine employment and fiscal results through specific estimates of employment and then revenues and costs to municipal government and finally to an evaluation of ICES's worth to the city. The indirect energy analysis compares energy resource requirements of the ICES with those for gas, oil, and electric systems now serving the community. DOE

**N79-28778#** Development Sciences, Inc., East Sandwich Mass  
**GUIDEBOOK ON INTEGRATED COMMUNITY ENERGY SYSTEMS: INDIRECT ECONOMIC AND ENERGY IMPACTS**

Nov 1978 79 p refs

(Contract W-31-109-eng-38)

(ANL/ICES-TM-16) Avail NTIS HC A05/MF A01

Descriptions of how indirect impacts of energy systems can be estimated are presented so that various members of the community can understand them and participate in the energy-related decisions. DOE

**N79-28779#** Brookhaven National Lab, Upton, N Y  
**APPLICATION OF RESOURCE ALLOCATION MODELS TO THE PROBLEMS OF REGIONAL ENERGY POLICY IN LARGE DEVELOPING COUNTRIES**

P M Meier and V Mubavi. 4 Jan 1979 35 p refs. Presented at Intern Seminar on Energy, Hyderabad India, 4-7 Jan 1979 (Contract EY-76-C-02-0016)

(BNL-25537, Conf-790134-1) Avail NTIS HC A03/MF A01

This paper explores the applicability of optimal resource allocation models designed primarily for already-developed economies, such as that of the U S, Canada and Western Europe, to the emerging problems of such developing countries was presented. The potential application of electric-utility-siting models is discussed in the context of electric grid expansion in the State of Andhra Pradesh in Southern India. Specific topics addressed include the degree to which models can be effectively used in the rather different conditions and priorities of industrializing countries, the requirements for basic-model reformulations to account for unique factors of geography and the ability to include and quantify environmental impacts of energy development as well as policy considerations relevant in the context of developing countries. DOE

**N79-28781#** Delegationen for Energiforskning, Stockholm (Sweden)

**ENERGY RESEARCH AND DEVELOPMENT IN SWEDEN, 1978-1981**

T Josefsson and L Ellwerth. Sep 1978 33 p refs

(DFE-13) Avail NTIS (US Sales Only) HC A03/MF A01, DOE Depository Libraries

The objectives, structure, budget, and organization of the three year program are described. The programs and subprograms are: energy use in industrial process (general studies, wood, pulp, paper, iron, steel, agriculture, horticulture, recycling, and recovery), energy use for transportation (transportation systems, energy use in vehicles), energy use for buildings (energy conservation, heat pumps, solar heating systems and solar energy storage, planning and control mechanisms, statistics, consumer requirements, planning and evaluation of experimental building activities), energy supply (domestic fuel sources, coal, synthetic fuels, light water reactors, hot water heating, wind energy, advanced energy technology, fusion). Funds for general energy system studies, fundamental research, planning and coordination, and international cooperation and other efforts related to the main program are indicated. DOE

**N79-28782#** Department of Energy, Washington D C, Office of Consumer Affairs

**ENERGY AND URBAN POLICIES/PROGRAMS: OFFICIAL TRANSCRIPT OF PUBLIC BRIEFING AND ADDENDUM, 27 APRIL 1978, WASHINGTON, D C**

Feb 1979 163 p

(DOE/IR-0042) Avail NTIS HC A08/MF A01

Sixty-one questions are indexed that were raised relative to the DOE public briefing on Energy and Urban Policies/Programs. Questions 1 through 40 were submitted by consumer and public interest groups prior to the briefing and answered by DOE program offices. With Ms Tina Hobson as moderator, the speakers and panelists answered some of the questions in their presentations. Those presenting speeches were Dr James Schlesinger, Sam Hughs, Alvin Alm, Donald A Beattie, William Peacock, Fr. Geno C Baroni, Walter Jabzanka. Three additional questions were read into the official record of the proceedings at the conclusion of the public briefing. Their answers were prepared by DOE program offices. Author (DOE)

**N79-28783#** Lincoln Lab, Mass Inst of Tech, Lexington  
**CONCEPTUAL DESIGN OF A PACKED BED FOR THERMAL-ENERGY STORAGE**

Nigel I Hamilton. 20 Dec 1978 56 p refs

(Contract EX-76-A-01-2295)

(CAES-10) Avail NTIS HC A04/MF A01

The design approach, conceptual design, and basic cost estimates for a packed bed for thermal-energy storage in an underground compressed-air-storage system are presented. The conceptual designs considered are a 200 MW(e) system operating on a weekly cycle, and a combined solar-thermal/compressed-air-storage system capable of delivering 100 MW(e) to the generator on discharge. Geological stresses in the thermal-energy storage cavity are examined. DOE

**N79-28784#** Los Alamos Scientific Lab, N Mex  
**DATA ACQUISITION FOR THE HOT DRY ROCK GEOTHERMAL ENERGY PROJECT**

Robert G Lawton and Everett H Horton. 1979 7 p refs. Presented at 25th Intern Instrumentation Symp, Anaheim, Calif, 7-10 May 1979

(Contract W-7405-eng-36)

(LA-UR-79-812, Conf-790505-2)

Avail NTIS HC A02/MF A01

The data acquisition system for the Hot Dry Rock Geothermal Energy Project at Fenton Hill in northern New Mexico, evolved to a computer controlled system complete with visual displays and emergency alarms. The system is comprised of two units. One unit monitors all surface facilities and during an energy extraction experiment is on-line 24 h a day. The other system is used for specialized downhole experiments. The data acquisition system is operator oriented so that a minimum crew can maintain the system. DOE

**N79-28787#** Department of Energy, Washington D C, Energy Information Administration

**SOLAR COLLECTOR MANUFACTURING ACTIVITY: Energy Data Report, Jul. 1977 - Jun. 1978**

Feb 1979 50 p refs

(DOE/EIA-0174) Avail NTIS HC A03/MF A01

Solar collector manufacturing activity is presented in tabular form by geographic location, producer size, collector type and use, and type of user. Producer shipments of solar collectors increased more than 1 million square feet (20.6 percent) over the shipments reported for six months prior. The number of manufacturers reporting sales remained relatively stable. Consequently, the statistics reflect an increase in production per company. A list of the manufacturers responding to the survey is included. DOE

**N79-28788#** Mueller Associates, Inc, Baltimore Md  
**SOLAR PROJECT COST REPORT**

H J Hale. 1978 30 p

(Contracts W-31-109-eng-38, EG-77-C-01-4049)

(SOLAR/2018-78/60) Avail NTIS HC A03/MF A01

A cost information for the Reedy Creek Utilities solar space heating, cooling, and service water heating project located in Walt Disney World, Florida is presented. The solar energy system cools, heats, and supplies service hot water for approximately 5624 square feet of office space in a general office building. The system was designed as an integral part of the building at the time the building was designed. The construction costs of

this solar project are presented in this report. Category costs are listed by materials, direct labor, and subcontract costs. The subcontract costs include both materials, labor, overhead and profit for electrical control and other minor subcontractors. DOE

**N79-28790#** Los Alamos Scientific Lab., N. Mex  
**SOLAR HEATING AND COOLING RESULTS FOR THE LOS ALAMOS STUDY CENTER**

J. C. Hedstrom, H. S. Murray and J. D. Balcomb. 1978. 7 p. ref. Presented at Conf. on Solar Heating and Cooling Systems Operational Results. Colorado Springs, Colo., 28 Nov - 1 Dec 1978.

(Contract W-7405-eng-36)

(LA-UR-78-2588, Conf-781236-1)

Avail NTIS

HC A02/MF A01

From Conference on solar heating and cooling systems operational results. Colorado Springs, Co, USA (28 Nov 1978). The solar energy system for the Study Center consists of an 8000 sq ft array of selectively coated, single-glazed collectors, a 5000 gallon pressurized tank for hot storage in the cooling mode, and a 10,000 gallon tank which is used for hot storage in the heating mode and cold storage in the cooling mode. Either of two chillers may be used in series with the cold storage tank, an 85 ton absorption unit or a 77 ton Rankine cycle unit. Night evaporative cooling is also used to cool the 10,000 gallon tank. A heat recovery unit is used to preheat fresh air in the winter and, by means of spraying the exhaust air, to pre-cool fresh air in the summer. Daily, monthly and seasonal energy summaries are presented for the system. Performance data for the two chillers include tabulation of thermal and system coefficients of performance. DOE

**N79-28791#** Public Service Co. of New Mexico, Albuquerque  
**TECHNICAL AND ECONOMIC ASSESSMENT OF SOLAR HYBRID REPOWERING. Final Report**

Sep 1978. 572 p. refs.

(Contract EG-77-C-03-1608)

(SAN-1608-4-1) Avail NTIS HC A24/MF A01

The study presented was divided into the six primary tasks to allow a systematic investigation of the concept: (1) market survey and cost/benefit analysis; (2) study unit selection; (3) cost estimates; (4) unit economic analysis; (5) program planning, future phases; and (6) program management. Reeves Station No. 2 at Albuquerque, New Mexico, was selected for repowering with a design goal of 50 percent (25 MWe). The solar system design is based on the 10 MW solar central receiver pilot plant preliminary design for Barstow, California. DOE

**N79-28792#** Radian Corp., McLean, Va.  
**COMPARISON OF ATMOSPHERIC FLUIDIZED BED COMBUSTION CONCEPTUAL DESIGNS FOR UTILITY STEAM GENERATION. Interim Report**

Feb 1979. 134 p. refs.

(Contract EX-76-A-01-2314)

(HCP/T-2314) Avail NTIS HC A07/MF A01

The information developed to date under the AFBC conceptual design project was reviewed to obtain a clear delineation of the state-of-the-art and technical feasibility of the technology and to develop a design on which to base an economic analysis of the technology. Three main conceptual designs for utility AFBC electric power generating plants were prepared under this program. Much of the merit of this effort is that the boilers were designed by established boiler manufacturers and the balance of the power plants designed by highly experienced architect-engineering firms. At present, the initial conceptual designs for the AFBC plants were completed. DOE

**N79-28812#** Department of Energy, Washington, D. C.  
**Div. of Environmental Control Technology  
 ENVIRONMENTAL CONTROL TECHNOLOGY ACTIVITIES OF THE DEPARTMENT OF ENERGY IN FY 1978**

Mar 1979. 108 p. refs.

(DOE/EV-0031) Avail NTIS HC A06/MF A01

This second in a series of annual reports on environmental control technology activities within DOE serves as a basis for

evaluating program progress. The total DOE-FY-78 funding allocation related to environmental control activities was \$294 million, which corresponds to 3.3% of the total FY-78 budget. Funding allocations for environmental control activities in the budget show fossil and nuclear energy technologies accounting for 90% of the total (26 and 64%, respectively). The majority of the fossil-energy-related activities were related to the coal program. Waste management activities demanded the majority of the nuclear energy funds. Conservation and geothermal made up 4 and 3% respectively, of the total. The remaining portion of the total consisted of solar (2%), basic energy sciences (1%), and magnetic fusion energy (less than 1%). Author (DOE)

**N79-28814#** Brookhaven National Lab., Upton, N. Y.  
**HIERARCHICAL DECOMPOSITION APPROACH TO ENVIRONMENTAL POLICY ANALYSIS**

William Marcuse. May 1978. 43 p. refs. Presented at Workshop on Econ. Meas. of Energy Related Environ. Damages, Golden, Colo., 21-22 Jun 1978.

(Contract EY-76-C-02-0016)

(BNL-24444, Conf-7806121-1)

Avail NTIS

HC A03/MF A01

A methodology for environmental analysis is presented that starts with the regional and national models, in this case the multi-regional energy system optimization model and the Brookhaven energy system optimization model used in a mode for solar technology assessment. Disaggregation to sectors was made through the Brookhaven Univ. of Illinois input-output model, and the national energy supply, energy demand, and nonenergy sectoral outputs were calibrated (used as control totals) for the regional model. The regional model is then used for energy siting through the county level electric facility siting model. The emissions, then localized at the county level, were fed into the emissions transport model that determines the air quality. These can then be used with a damage function to determine the health impact of energy generation emissions and with appropriate coefficients, to determine the health impacts of extraction, transport and processing. DOE

**N79-28932#** Sandia Labs., Livermore, Calif.  
**USER'S GUIDE FOR MIRVAL: A COMPUTER CODE FOR COMPARING DESIGNS OF HELIOSTAT-RECEIVER OPTICS FOR CENTRAL RECEIVER SOLAR POWER PLANTS**

P. L. Leary and J. D. Hankins. Feb 1979. 128 p. refs.

(Contract EY-76-C-04-0789)

(SAND-77-8280) Avail NTIS HC A07/MF A01

MIRVAL is a Monte Carlo program which simulates the heliostats and a portion of the receiver for solar energy central receiver power plants. Models for three receiver types and four kinds of heliostats are included in the code. The three receiver types modeled are an external cylinder, a cylindrical cavity with a downward-facing aperture, and a north-facing cavity. Three heliostats which track in elevation and azimuth are modeled, one of which is enclosed in a plastic dome. The fourth type consists of a rack of louvered reflective panels with the rack rotatable about a fixed horizontal axis. Phenomena whose effects are simulated are shadowing, blocking, mirror tracking, random errors in tracking and in the conformation of the reflective surface, optical figure of the reflective surface, insolation, angular distribution of incoming sun rays to account for limb darkening and scattering, attenuation of light between the mirrors and the receiver, reflectivity of the mirror surface, and mirror aiming strategy. DOE

**N79-29021#** Interagency Review Group on Nuclear Waste Management, Washington, D. C.

**REPORT TO THE PRESIDENT BY THE INTERAGENCY REVIEW GROUP ON NUCLEAR WASTE MANAGEMENT**  
 Mar 1979. 251 p. refs.

(TID-29442) Avail NTIS HC A12/MF A01

Nuclear waste disposal and the future use of nuclear energy and the scope and magnitude of waste management are discussed. Emphasis is placed on national goals, planning objectives, criteria, and procedures for nuclear waste management to guide policy, planning, program, regulatory, and research and development.



activities Technical strategies for high-level and transuranic wastes, low-level waste, uranium mill tailings and waste generated by D&D activities are included Institutional issues and management considerations including recommendations for follow-on implementation are covered Work plans for each major type of waste based on the goals decisions and interim strategic planning bases are given J M S

**N79-29037\*** National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville Ala  
**RADIATION SHADOW INDICATOR Patent**  
Richard A Campbell, inventor (to NASA) Issued 3 Jul 1979 8 p Filed 31 Oct 1978 Continuation of abandoned US Patent Appl SN-778311 filed 16 Mar 1977  
(NASA-Case-MFS-23546-2, US-Patent-4,159,576, US-Patent-Appl-SN-956167, US-Patent-Class-33-281, US-Patent-Class-33-1H, US-Patent-Class-350-83) Avail US Patent and Trademark Office CSCL 20F

A radiation shadow indicator having a slight tube for sighting shadow-casting objects along a sighting axis is described The indicator includes a system of gimbals mounting the tube for angular movement so that the sighting axis thereof may be caused to follow the apparent diurnal movement of celestial objects at various seasons of the year Position indicators are provided for instantaneous readout of angular positions of the gimbal device which, in turn, correspond to positions of the sighting axis at given seasons and/or times of day in relation to the location of the indicator on the surface of the earth

Official Gazette of the U S Patent and Trademark Office

**N79-29051#** Nagoya Univ (Japan) Inst of Plasma Physics  
**TRENDS OF PLASMA PHYSICS AND NUCLEAR FUSION RESEARCH LIFE CYCLE AND RESEARCH EFFORT CURVE**  
Takeru Ohe, Yasumasa Kanada, Hiromu Mamota, and Yoshi H Ichikawa May 1979 36 p refs  
(IPPJ-396) Avail NTIS HC A03/MF A01

A quantitative analysis of research trends in the fields of plasma physics and nuclear fusion is presented The analysis is based on information retrieval from available data bases The results indicate that plasma physics research is now in the maturation phase of its life cycle, and that nuclear fusion research is in its growth phase It was found that there is a correlation between the number of accumulated papers in the fields of plasma physics and nuclear fusion and the experimentally attained values of the plasma ignition parameter nT Using this correlation research effort curve it is forecast that the scientific feasibility of controlled fusion using magnetic confinement systems will be proved around 1983 G Y

**N79-29061#** Sandia Labs, Albuquerque, N Mex  
**NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report**  
Frederick G Blottner, Anthony J Russo, John G Taylor, and G Ronald Hadley Feb 1979 23 p refs  
(Contract EY-78-C-04-0789)  
(SAND-78-1954) Avail NTIS HC A02/MF A01

Numerical techniques and codes for characterizing coal combustion-operated MHD generators and diffusers were developed The work called for four tasks, (1) development of a one-dimensional channel code, (2) development of multidimensional channel codes, (3) conduct slag layer studies and heat transfer analyses, and (4) study arc formation, migration, and electrode erosion A summary of the current progress on these tasks is presented DOE

**N79-29105#** Committee on Science and Technology (U S House)

**NASA AUTHORIZATION, 1980, VOLUME 1, PART 2**  
Washington GPO 1979 427 p refs Hearing on HR 1786 before the Comm on Sci and Technol, 96th Congr, 1st Sess, 6 Feb 1979

(GPO-46-134) Avail Comm on Sci and Technol

The President's budget for NASA is reviewed in the light of his civilian space policy and its impact on NASA programs

Major activities of FY 1980 highlighted include the space transportation system, space sciences, space and terrestrial applications, aeronautics and space technology, space tracking and data systems, construction of facilities, research and program management and international programs The budget request is considered to comprise a sound, balanced aeronautics and space program, given the constraints of the national anti-inflationary effort It supports the continued development of the space transportation system, meets commitments made in the past, maintains progress in ongoing programs, and provides for flexibility in future programs A R H

**N79-29106\*#** Jet Propulsion Lab, Calif Inst of Tech, Pasadena  
**HYDROGEN-FUELED POSTAL VEHICLE PERFORMANCE EVALUATION**

R A Hall 15 Jun 1979 28 p Prepared for NASA, DOE, and US Postal Service  
(Contract NAS7-100)

(NASA-CR-158811, JPL-PUB-79-55) Avail NTIS HC A03/MF A01 CSCL 13F

Fuel consumption, range, and emissions data were obtained while operating a hydrogen-fueled postal delivery vehicle over a defined Postal Service Driving Cycle and the 1975 Urban Driving Cycle The vehicle's fuel consumption was 0.366 pounds of hydrogen per mile over the postal driving cycle and 0.22 pounds of hydrogen per mile over the urban driving cycle These data correspond to 6.2 and 10.6 mpg equivalent gasoline mileage for the two driving cycles, respectively The vehicle's range was 24.2 miles while being operated on the postal driving cycle Vehicle emissions were measured over the urban driving cycle HC and CO emissions were quite low as would be expected The oxides of nitrogen were found to be 4.86 gm/mi, a value which is well above the current Federal and California standards Vehicle limitations discussed include excessive engine flashbacks, inadequate acceleration capability the engine air/fuel ratio, the water injection systems, and the cab temperature Other concerns are safety considerations, iron-titanium hydride observed in the fuel system, evidence of water in the engine rocker cover, and the vehicle maintenance required during the evaluation A R H

**N79-29108\*#** National Aeronautics and Space Administration, Washington, D C

**SPINOFF 1979 Annual Report**

James J Haggerty Feb 1979 118 p Original contains color illustrations

(NASA-TM-80481) Avail NTIS MF A01, SOD HC \$4.25 CSCL 05A

NASA's current mainline programs which are producing public benefit through direct application of technology and, at the same time, are generating new technology which may find secondary application in the future are summarized A representative sampling of spinoff products and processes derived from NASA technology and employed in various avenues of everyday life is included The mechanisms of the technology transfer process, including the means by which NASA seeks to stimulate technology utilization are described as well as NASA's activities in assisting agencies interested in exploiting the benefit potential of satellite remote sensing technology A R H

**N79-29110\*#** Mechanical Technology, Inc, Latham, N Y  
**CONCEPTUAL DESIGN STUDY OF AN AUTOMOTIVE STIRLING REFERENCE ENGINE SYSTEM**

Jun 1979 31 p Prepared for NASA and DOE

(Contracts DEN3-32, EC-77-A-31-10040)

(NASA-CR-159605, MTI-79ASE53RE1A)

DOE/NASA/0032-79/1) Avail NTIS HC A03/MF A01 CSCL 13F

The studies that were made the methodology that was used and the results which support the concluded recommendation of a four cylinder, double acting square U design, with external regenerators are described Optimization of this design concept resulted in a calculated fuel economy of 36.3 mpg for a 3200 pound vehicle, compared to the program goal of 30.0 mpg, and acceleration time of 13.1 seconds compared to the program goal of 15.0 seconds The engine will meet or exceed the program

emission goals of HC < 0.41 gram/mile, CO < 3.4 gram/mile and nitrogen oxide < 0.4 gram/mile A R H

**N79-29115#** Oak Ridge National Lab., Tenn  
**ENERGY INTENSITY AND RELATED PARAMETERS OF SELECTED TRANSPORTATION MODES PASSENGER MOVEMENTS**

A B Rose Jan 1979 177 p refs

(Contract W-7405-eng-26)

(ORNL-5506) Avail NTIS HC A09/MF A01

A study was undertaken aimed at determining the causes of the divergences among published energy-intensity values and at preparing a set of consistent values. The findings in relation to the passenger-transportation modes are presented. After a brief overview of the important factors to be considered and the potential pitfalls facing users and analysts of energy-intensity values, a chapter is devoted to each of the major means of passenger transportation: air, automobile, bus, and rail. In each of these chapters, after a critique of the available data sources, a consistent time series of operational data and energy-intensity values is presented for the major sectors of each mode. Engineering simulations and data analysis are also carried out. Matrices giving the great-circle distances and modal-circuit ratios among the 50 largest standard metropolitan statistical areas are included.

DOE

**N79-29116#** California Univ., Livermore Lawrence Livermore Lab

**PRELIMINARY DESIGN ANALYSIS OF THE QUASI-ELECTRIC DRIVE VEHICLE**

M W Schwartz and E Lorbeer Dec 1978 31 p refs

(Contract W-7405-eng-48)

(UCRL-52613) Avail NTIS HC A03/MF A01

The capability of a four-passenger, quasi-electric drive vehicle of acceptable weight to obtain a range of 80 km with improved lead acid batteries was verified. The dual-fueled hybrid vehicle described is basically an electric vehicle (EV) augmented by a small heat-engine hybrid propulsion system for extended range capability. Usually the vehicle operates as an EV, since 75% of vehicle miles traveled in the United States consist of trips of 80 km (50 mi) or less. For longer trips, the driver may select the heat-engine hybrid mode or permit automatic switching to heat-engine power when the batteries reach a prescribed level of discharge. Three candidate propulsion systems having the greatest potential for early marketability were selected. Of the three systems analyzed, the flywheel/hydropneumatic transmission configuration requiring the smallest battery mass is the lightest and most efficient.

DOE

**N79-29118#** Ford Motor Co., Dearborn, Mich  
**FORD/DOE SODIUM-SULFUR BATTERY ELECTRIC VEHICLE DEVELOPMENT AND DEMONSTRATION, PHASE 1 Quarterly Progress Report, 1 Dec 1977 - 28 Feb 1978**

A Topouzian 1978 27 p

(Contract EY-76-C-02-2566)

(COO-2566-37, QPR-37) Avail NTIS HC A03/MF A01

Progress in developing an electric vehicle with sodium-sulfur batteries is reported. Information is included on NaS cell and battery trade off studies, preliminary vehicle packaging studies, projects on vehicle performance and cost, and motor/controller studies.

DOE

**N79-29120#** General Accounting Office, Washington, D C  
 Energy and Minerals Div

**THE CONGRESS NEEDS TO REDIRECT THE FEDERAL ELECTRIC VEHICLE PROGRAM**

9 Apr 1979 67 p

(PB-293977/5 EMD-79-6) Avail NTIS HC A04/MF A01  
 CSCL 13F

Today's vehicles have limited commercial potential because they cost more and perform poorly compared with conventional vehicles. The GAO's review of the Department of Energy's program to develop, demonstrate, and commercialize electric vehicles recommends that electric vehicle research and development be

strengthened. Vehicle demonstrations be limited initially to the Federal sector and loan guarantees for commercial production be delayed. The Congress should make the legislative changes and take other actions needed for program redirection. GRA

**N79-29212#** Committee on Science and Technology (U S House)

**SOLAR POWER SATELLITE**

Washington GPO 1979 344 p refs. Hearings before the Subcomm on Space Sci and Applications of the Comm on Sci and Technol., 96th Congr., 1st Sess., 28-30 Mar 1979.

(GPO-45-997) Avail Subcomm on Space Sci and Applications

A technology verification program to enable the resolution of the technical, environmental, and economic issues surrounding the concept of a solar power satellite is considered. Specific issues discussed include biological and ionospheric impacts, radio frequency interference, and research on the space segment of the microwave power system to ensure technical and economic feasibility.

J M S

**N79-29234** Delaware Univ., Newark

**CATALYST DEACTIVATION IN THE HYDROPROCESSING OF COAL-DERIVED LIQUIDS Ph.D Thesis**

Minshon Jebb Chiou 1979 229 p

Avail Univ Microfilms Order No 7918801

Aged catalysts used in H-coal liquefaction process were analyzed with a scanning electron microscope and an electron microscope. The results show that the deposition of coal mineral matter is a general phenomenon in the hydroprocessing of coal slurries. Kinetic simulations were developed to investigate the effect of coke laydown causing pore blockage and the effect of partially closed pores on hindered diffusion of larger molecules. The results show that sometimes improvements in catalyst life and activity level can be obtained by proper selection of the pore size. The moment analysis method was extended for microreactors by representing the internal diffusion processes in the catalyst as a solid film resistance. This approximation simplifies the experimental analysis for complex reaction system.

Dissert Abstr

**N79-29249#** Bureau of Mines, Twin Cities, Minn

**STABILITY OF ALUMINA-BASE REFRACTORIES IN WESTERN LIGNITE-ASH SLAG ENVIRONMENTS**

J E Pahlman, C F Anderson, and S E Khalafalla 1979 22 p refs

(PB-293238/2, BM-RI-8334) Avail NTIS HC A02/MF A01  
 CSCL 11B

The use of Western lignites and subbituminous coals for firing pellet induration and metallization furnaces requires that the refractory linings of these furnaces be able to withstand attack from corrosive alkali metal oxides present in the ash of many of the low-rank fossil fuels. Dynamic and static slag tests on high-alumina and alumina-silica refractories show that increased alkali content in the lignite ash caused increased corrosion and erosion of the tested refractories. The degree of corrosion decreased with increasing alumina content, with the 99-percent-alumina refractories having the highest resistance. Also, porosity reduction and tar impregnation enhanced the corrosion and erosion resistance.

GRA

**N79-29271#** Department of Energy, Washington, D C  
 Div of Fossil Fuel Utilization

**SECOND ANNUAL COMBUSTION AND FUELS TECHNOLOGY PROGRAM CONTRACTOR REVIEW MEETING**

1978 291 p refs. Meeting held at Arlington, Va., 18-21 Sep 1978.

(CONF-7809103) Avail NTIS HC A13/MF A01

Topics covered in papers presented at the meeting include combustion technology, waste fuel utilization, boilers and furnaces, internal combustion engines, engine optimization, exhaust emissions, effects of microwaves on combustion, swirl combustors, Raman scattering, laser spectroscopy, uses in combustion research, alternative fuels, and residues and wastes.

DOE

**N79-29276#** Bureau of Mines, Rolla, Mo Metallurgy Research Center  
**CHEMICAL VAPOR DEPOSITION OF WEAR-RESISTANT COATINGS**

J B Stephenson, D M Soboroff, H O McDonald, and A A Cochran 1979 14 p refs  
 (BM-RI-8348) Avail NTIS HC A02/MF A01

The feasibility of hardfacing the critical surfaces of valves and similar devices by chemical vapor deposition was investigated in order to increase the wear resistance of these components for use in the abrasive and erosive environment of coal gasification units Tungsten and molybdenum coatings were produced on nickel plated carbon steels and stainless steels by hydrogen reduction of the metal hexafluoride at 325 to 600 C Titanium nitride coatings were produced on low-carbon steels by the reaction of titanium tetrachloride, hydrogen, and nitrogen at 1,000 C Titanium carbonitride coatings were produced on low-carbon steels by the reaction of nitrogen, hydrogen, and methane at 900 C DOE

**N79-29305#** Argonne National Lab, Ill Materials Science Div  
**CORROSION OF METALS IN COAL-GASIFICATION ENVIRONMENTS**

K Natesan 1979 50 p refs Presented at Conf on Corrosion-Erosion of Coal-Conversion System Mater, Berkeley, Calif, 24-26 Jan 1979  
 (Contract W-31-109-eng-38)  
 (CONF-790145-2) Avail NTIS HC A03/MF A01

Thermodynamic aspects of high temperature corrosion processes that pertain to coal conversion were discussed, and kinetic data were used to compare the behavior of different commercial materials of interest Regimes for corrosion protection via oxide formation on the materials were defined relative to alloy chemistry, oxygen and sulfur partial pressures in the gas environment, and temperature Areas of additional research with particular emphasis on alloy design for improved corrosion resistance were identified DOE

**N79-29353** Stanford Univ, Calif  
**IN-SITU COMBUSTION MODELS FOR THE STEAM PLATEAU AND FOR FIELDWIDE OIL RECOVERY**  
 Ph.D. Thesis

Abdurrahman Satman 1979 124 p  
 Avail Univ Microfilms Order No 7917278

The steam plateau region of laboratory combustion tube experiments was studied and heat transfer modes describing the steam plateau were defined The combustion parameters affecting the steam plateau were also studied and evaluated An analytical heat model was developed which describes the movement of the steam plateau axially along a cylinder with heat loss through an annular insulation Correlations were developed to predict field scale recovery of dry in-situ combustion processes After developing the correlations, their validity was tested The match between the correlations and field test results was satisfactory The study shows that the recovery correlations developed for dry combustion processes may be used for the recovery prediction of the wet combustion test in which the air-water injected ratio is high Dissert Abstr

**N79-29354\*#** California Univ, Los Angeles School of Engineering and Applied Science

**FORECAST OF FUTURE AVIATION FUELS. PART 1: SCENARIOS Progress Report, 1 Aug. 1976 - 20 Sep. 1977**  
 J M English, C Y Liu, J L Smith, A K K Yin, G A Pan, M B Ayati, M Gyamfi, and M R Arabzadah 17 Mar 1978 140 p refs Revised  
 (Grant NsG-3116)  
 (NASA-CR-158871, UCLA-ENG-77-78-Pt-1) Avail NTIS HC A07/MF A01 CSCL 21D

A preliminary set of scenarios is described for depicting the air transport industry as it grows and changes, up to the year 2025 This provides the background for predicting the needs for future aviation fuels to meet the requirements of the industry

as new basic sources, such as oil shale and coal which are utilized to supplement petroleum Five scenarios are written to encompass a range of futures from a serious resource-constrained economy to a continuous and optimistic economic growth A unique feature is the choice of one immediate range scenario which is based on a serious interruption of economic growth occasioned by an energy shortfall This is presumed to occur due to lags in starting a synfuels program Author

**N79-29356#** Committee on Commerce, Science, and Transportation (U S Senate)

**LIQUEFIED ENERGY GASES, PART 2**

Washington GPO 1978 388 p refs Hearings before the Comm on Commerce, Sci, and Transportation, 95th Congr, 2d Sess, 12-13 Dec 1978  
 (GPO-39-305) Avail Comm on Commerce Sci and Transportation

Problems related to the handling, transportation, and storage of liquefied natural gas and liquefied petroleum gases are discussed with emphasis on jurisdictional ambiguities regulatory delays, preemption accident control, liability, compensation inspection and enforcement efforts Safety management and environment protection aspects are also considered A R H

**N79-29364#** Monsanto Research Corp., Dayton Ohio  
**ANALYSIS OF THE EMISSIONS FROM STORAGE TANKS DURING JP-4 FUEL TRANSFER OPERATIONS PHASE 1 WARM WEATHER CONDITIONS Final Report**

W R Fearheller 1 May 1979 66 p refs  
 (Contract F41608-78-C-1240)  
 (AD-A069339) Avail NTIS HC A04/MF A01 CSCL 21/4

This report summarizes the warm weather phase of a program to measure the concentration of JP-4 vapor that is emitted to the atmosphere during filling of underground storage tanks Tests were conducted with and without pressure - vacuum breather valves Samples were analyzed by a portable total hydrocarbon analyzer containing a flame ionization detector Data was recorded at one minute intervals during the fuel transfer operations All data was collected during August and September 1978 from 50,000 gallon underground JP-4 fuel storage tanks at Wright-Patterson AFB, OH Author (GRA)

**N79-29365#** Sandia Labs, Albuquerque N Mex  
**VISCOSITY REDUCTION OF COAL LIQUIDS BY DISSOLVED CARBON DIOXIDE**

A D Yu and F M Orr, Jr Mar 1979 48 p refs  
 (Contract EY-76-C-04-0789)  
 (SAND-79-7027) Avail NTIS HC A03/MF A01

The solubility of carbon dioxide in coal liquids and the viscosities of mixtures of coal liquids with CO2 were measured Carbon dioxide in coal liquids was found to be comparable to its solubility in crude oils It is sufficiently soluble to provide substantial viscosity reductions at concentrations below 10 weight percent Significant precipitation of heavy hydrocarbon materials was observed during the viscosity measurements DOE

**N79-29366#** Sandia Labs, Albuquerque, N Mex  
**COAL LIQUEFACTION CATALYST TAGS**

D G Sample and M G Thomas Feb 1979 28 p refs  
 (Contract EY-76-C-04-0789)  
 (SAND-79-0017) Avail NTIS HC A03/MF A01

The identification and analysis of tagged catalysts from catalytic and liquefaction reactors that employ addition and withdrawal of catalysts can provide mixing characteristics and deactivation rates Several methods for tagging coal liquefaction catalysts which were developed and evaluated include physical alternation, metals addition, and nuclear activation Sputtering (vapor deposition) and painting (metal paints) are methods used for doping catalysts with metal tags which can be identified using radiographic techniques Machining and filing catalysts and altering extrusion dies can provide physical tags identified optically and by radiographic techniques Neutron activation provides tags identified by a standard radiation counting method The tags are evaluated on the bases of preparation, integrity, and detection The use of the tags is considered for use in an H-Coal process demonstration unit DOE

**N79-29367#** Gulf Research and Development Co., Pittsburgh, Pa

**INVESTIGATION OF MECHANISMS OF HYDROGEN TRANSFER IN COAL HYDROGENATION Quarterly Progress Report, Jan. - Mar. 1978**

D C Cronauer, R G Ruberto, Y T Shah, and R Modi Apr 1978 54 p refs

(Contract EX-76-C-01-2305)

(FE-2305-21) Avail NTIS HC A04/MF A01

Preparation of asphaltene samples for preliminary hydrogen transfer experiments was accomplished, and the experiments were started. The first samples of asphaltenes were recovered from distillation residues. (In this regard, asphaltenes were considered as the fraction insoluble in pentane and soluble in toluene.) The levels of recoverable asphaltenes in the residues was shown to be 62 and 45%. Operating problems observed in the use of asphaltenes were primarily due to limitations of asphaltene solubility in tetralin. DOE

**N79-29368#** Oak Ridge National Lab., Tenn Chemical Technology Div

**MATHEMATICAL MODEL OF THE HYGAS PILOT PLANT REACTOR**

J P Meyer, J W Wells, J R Cox, J P Belk, and G C Frazier 1979 33 p refs Presented at the Am Inst of Chem Engr, Houston, Tex., 1-5 Apr 1979

(Contract W-7405-eng-26)

(CONF-790405-11) Avail NTIS HC A03/MF A01

A mathematical model of the HYGAS pilot plant reactor was developed by subdividing the gasification process into the independent and sequential steps of devolatilization, volatile cracking, rapid-rate methane formation, and slow-rate hydrogasification. Algorithms for each step were obtained from the literature for Montana lignite and Illinois No 6 coal. Results from this work indicate that, for a given coal type, the product gas composition from the reactor does not vary significantly over the range of operating conditions. In general, results from the model compared favorably with pilot plant data for the gas composition, overpredicted the reported temperature profile, and were mixed with regard to the published extent of conversion, depending on coal type. Reasons for these discrepancies were attributable to inadequacies in model formulation, the assumption of adiabatic behavior, and uncertainties in the data. DOE

**N79-29369#** SRI International Corp., Menlo Park, Calif  
**PRELIMINARY MARKET EVALUATION FOR GAS PRODUCED BY UNDERGROUND GASIFICATION OF WESTERN COAL**

D L Olsen, A J Moll, R L Dickenson, C A Trexel, G Crooks, and N R Teater Aug 1978 92 p refs

(Contract EY-76-C-03-0115)

(SAN-0115-T124-1, SRI-6581) Avail NTIS

HC A05/MF A01

The technical development of underground coal gasification (UCG) depends on the success of existing private and governmental programs. Opportunities for application of UCG-derived fuel gas in existing industrial facilities are limited and site-specific. The potential market in the United States for competitively priced SNG from UCG-derived intermediate BTU gas (IBG) is essentially supply limited through the end of this century, that is, the nation's natural gas transportation and from the UCG sources likely to be developed by the year 2000. Retrofitting existing oil- or gas-fired power plants to accommodate IBG may be attractive in some cases as an alternative to a more costly conversion to coal-fired systems. Technical suitability, gas transportation costs, and ease of retrofit favor IBG over low BTU gas in applications for UCG-derived gases, such as chemical feedstocks, synthetic natural gas precursors, industrial fuels, or retrofit power plant fuels must be considered. DOE

**N79-29370#** Department of Energy, Washington, D C Energy Technology Center

**CLEAN ENERGY FROM COAL**

Jan 1979 36 p refs

(PETC-1000) Avail NTIS HC A03/MF A01

The Pittsburgh Energy Technology Center (PETC) program to promote production of clean energy from coal is described. Established in 1948 as an energy research laboratory of the Office of Synthetic Liquid Fuels, U S Bureau of Mines, PETC is the largest fossil energy research and development center in the U S. PETC has a staff of about 350 scientists, engineers, technicians, and support personnel and is the major Federal laboratory for research in coal combustion and conversion of coal to clean fuels. The laboratories were built in the late 1940's after the Congress passed the Synthetic Liquid Fuels Act of 1944. DOE

**N79-29371#** Elrick and Lavidge, Inc., San Francisco, Calif  
**COMMERCIALIZATION FOCUS GROUP INTERVIEW: MEDIUM AND LOW Btu COAL GASIFICATION Summary Report**

Aug 1978 14 p

(Contract EV-78-C-01-6457)

(DOE/TIC-10029) Avail NTIS HC A02/MF A01

DOE's background papers indicate that the technology necessary for commercialization of medium and low Btu coal gasification is available. All of the respondents agree with this statement. The federal government is seen as having a role to play in the commercialization of this fuel alternative, including funding a demonstration unit, guaranteeing loans for a few of the following units and providing protection for industry innovators by establishing an explicit, stable energy policy. The government's policy of price regulation is obviously of extreme importance to people considering the major financial expenditures necessary to make these fuel alternatives commercially available. DOE

**N79-29372#** Kaiser Engineers, Oakland, Calif  
**TECHNICAL AND ECONOMIC FEASIBILITY STUDY FOR THE INDUSTRIAL UTILIZATION OF WASTE DERIVED FUEL GAS**

Feb 1979 50 p

(Contract EM-78-C-03-2092)

(SAN-2092-T1) Avail NTIS HC A03/MF A01

A plan is presented for managing a technical and economic feasibility study for producing waste-derived fuel gas and using it as auxiliary fuel in a steel plant and in a California power plant. The project involves processing urban refuse, sewage, and agricultural (dairy) wastes to produce medium-Btu fuel gas to the users. The personnel requirements, procedures, documentation requirements, and time schedule, are outlined. DOE

**N79-29373#** Insitu Consulting, Laramie, Wyo  
**BIBLIOGRAPHY OF SUBSIDENCE AND RELATED TOPICS FOR IN SITU COAL GASIFICATION**

C R McKee and A Serafini Oct 1978 137 p refs

(LETG/BL-71318-1) Avail NTIS HC A07/MF A01

The topics included are subsidence, subsidence models, material properties and in situ measurements, and hydrology of fractured media. Each topic is indexed by year and then alphabetically by author within each year. Abstracts of each article are included when available. DOE

**N79-29374#** California Univ., Davis Dept of Mechanical Engineering

**TRIAXIAL TESTS OF COAL GASIFICATION SAMPLES Final Report**

H Brandt 1978 223 p refs

(Contract W-7405-eng-48)

(UCRL-13968) Avail NTIS HC A10/MF A01

Samples were obtained from core borings at Hoe Creek in-situ coal gasification site at Campbell County, Wyoming. A total of forty-five triaxial tests were made in which overburden and interstitial pressures were kept constant. Data analysis such as geological grouping of the samples, determination of mathematical functions for stress and strain and development of failure envelopes was also performed. DOE

**N79-29375#** SRI International Corp., Menlo Park, Calif  
**MISSION ANALYSIS FOR THE FEDERAL FUELS FROM BIOMASS PROGRAM. VOLUME 2: MISSION SELECTION, MARKET PENETRATION MODELING, AND ECONOMIC EVALUATION Final Report**

Fred A Schooley, Katherine A Miller, Paul C Meagher, Gwen Crooks, Claudia Grill, and Ronald L Dickenson Dec 1978 69 p refs

(Contract EY-76-C-03-0115-131)

(TID-29091) Avail NTIS HC A04/MF A01

The market penetration model is described and the procedure used in selecting for analysis missions with potential for commercialization is identified. The inputs to the market penetration model are discussed, except for feedstock availability data. The model inputs include conventional fuel prices and demands and mission conversion economics. DOE

**N79-29376#** Department of Energy, Washington D C Energy Information Administration

**ASSESSMENT OF POTENTIAL US PETROLEUM SUPPLY SHORTFALLS, 1978**

Daniel Butler 2 Jun 1978 14 p

(DOE/EIA-0102/38) Avail NTIS HC A02/MF A01

The petroleum allocation model presented was developed by the EIA for the purpose of estimating future sources of petroleum imports to the United States and to calculate expected shortfalls in those imports that would result from supply interruptions. The model simulates total world trade in both crude oil and refined products and in the case of a supply emergency, shares available petroleum supplies among member countries of the International Energy Agency as dictated in the International Energy Program. DOE

**N79-29377#** Princeton Univ., N J Dept of Mechanical and Aerospace Engineering

**SYMPOSIUM ON ADVANCES IN SYNTHETIC FUELS PRESENTED BEFORE THE DIVISION OF PETROLEUM CHEMISTRY, AMERICAN CHEMICAL SOCIETY**

M J Antal, Jr and T B Reed (Solar Energy Research Inst., Golden, Colo.) 1978 9 p refs Meeting held at Miami Beach Fla., 10 - 15 Sep 1978

(Contract ET-78-F-02-5058)

(CONF-780902-16) Avail NTIS HC A02/MF A01

The effects of gas phase temperature and residence time on the products of the pyrolysis/steam reforming of red alder pellets were investigated. Of the conditions studied, residence times of 6 to 9 seconds at 700 C produces the largest quantity of medium Btu gas from the pellets. The quantity of gas produced is less than one-half that obtained from cellulose under similar conditions. This relative paucity of gas yield may be an artifact of the pelletizing process or it may reflect an inherent difficulty in gasifying red alder wood. More extreme conditions than examined here could be used to obtain higher gas yields. However, the high cost of reactors utilizing extreme conditions militates against their use for biomass gasification. More research is needed to determine the desirability of pelletized fuels for gasification processes, and the optimal conditions for steam pyrolysis/gasification of biomass. DOE

**N79-29378#** Badger Plants Inc., Cambridge, Mass  
**COAL-TO-GASOLINE CONCEPTUAL DESIGN AND MARKET EVALUATION OF METHANOL FUEL AND METHANOL-DERIVED GASOLINE Quarterly Technical Progress Report, 31 Jul - 27 Oct 1978**

1978 11 p

(Contract EX-76-C-01-2416)

(FE-2416-37) Avail NTIS HC A02/MF A01

Conceptual design work completed during the quarter on the conversion of coal to gasoline using the Mobil M-gasoline process is summarized. Preliminary work done on the marketing study for methanol is also summarized. DOE

**N79-29379#** Brookhaven National Lab., Upton N Y

**HYDROGEN TECHNOLOGY AN OVERVIEW**

F J Salzano, A Mezzina, M Beller, G Strickland and S Srinivasan 1979 15 p Presented at the 177th ACS Natl Meeting, Honolulu Hawaii, 1 Apr 1979

(Contract EY-76-C-02-0016)

(BNL-25760 Conf-790415-16)

Avail NTIS

HC A02/MF A01

The key technologies needed for hydrogen to make major inroads into the U.S. energy economy as a fuel derived from renewable or abundant nonfossil resources is presented. The unique relationship between hydrogen and the fuel cell is discussed. The state-of-the-art of hydrogen transmission and storage are presented, and a scenario shows how the commercialization of the fuel cell as an electric-generating device in urban areas could lead to the introduction and use of hydrogen in a wider variety of end uses. At the present time there is a great deal of international interest in hydrogen. A broad picture of the activities of a number of western European countries and Japan in the area of hydrogen and a summary of international interest in this area is presented. DOE

**N79-29381#** Office of Technology Assessment, Washington D C

**THE DIRECT USE OF COAL PROSPECTS AND PROBLEMS OF PRODUCTION AND COMBUSTION**

Apr 1979 426 p refs

(PB-295797/5 OTA-E-86, LC-79-600071) Avail NTIS HC A19/MF A01 CSCL 081

The benefits and risks of a massive shift to coal and away from other fuels is assessed. The social, economic, physical, and biological impacts of such a shift is studied. The complete coal system, from extraction to combustion including the key steps and institutions that policy can influence is examined. The environmental impacts and possible effects on the public health are documented. Occupational and community impacts are examined. Technologies under development that might reduce cost, increase convenience of use, or mitigate negative impacts are reviewed. GRA

**N79-29384#** Oak Ridge Y-12 Plant Tenn

**AUTOMATIC TENSION CONTROL FOR WINDING SUPER-CONDUCTING COILS**

G M Henderson, J C Hung and J M Googe 1979 8 p refs Presented at Southeastcon 79 IEEE Region 3 Conf and Exhibit Roanoke Va., 1 Apr 1979 Submitted for publication Prepared in cooperation with Tenn Univ Knoxville

(Contract W-7405-eng-26)

(Y/EN-257 Conf-790410-1) Avail NTIS HC A02/MF A01

Root locus techniques were utilized in arriving at a suitable compensation network to stabilize the tension machine control system. Simulated tests of the system's response to a step input and to a pulse disturbance were performed. A mathematical model of the tension machine and the associated feedback control system is presented. A stability analysis of the system along with the applicability of a commercial controller for compensation requirements is discussed as well as simulated system responses to a step input and to a pulse disturbance. DOE

**N79-29513#** Addis Translations International, Portola Valley Calif

**LASER AND ENERGETICS OF THE FUTURE**

N Basov and L Feoktistov Mar 1979 8 p Translated into ENGLISH from Pravda, USSR no 35, 8 Mar 1978

(UCRL-Trans-11467) Avail NTIS HC A02/MF A01

It is shown that atomic energy should and can be viewed by mankind not as a military threat but as a source of abundant energy. The achievements of science provide sufficient grounds for this. Of course, controlling the fusion reaction is not the only possible solution to the energy problem. Moreover, it is widely believed that the most important role in this sphere belongs to energy produced by uranium fission. This suggests that other possible sources such as solar, geothermal energy will either not be developed in time or will not provide an adequate solution. DOE

**N79-29521#** Harry Diamond Labs., Adelphi Md

**AN INITIAL MODEL FOR THE FINITE DISPLACEMENT RESPONSE CHARACTERISTICS OF A FLUIDYNE PUMP**

Tadeusz M Drzewiecki Feb 1979 43 p refs

(DA Proj 1T1-61101-A-91A)

(AD-A069159, HDL-TR-1868) Avail NTIS HC A03/MF A01

CSCL 20/13

This paper is the final report on the independent laboratory in house research (ILIR) sponsored work by the Harry Diamond Laboratories on the Fluidyne pump. The effort started with a survey of the extant literature on the subject, continued with experimental observations that led to a mathematical model, and has culminated with a comprehensive statement on the physical operation of the pump. The literature is particularly sparse on the subject, hence, only the basic references are cited. The report presents a detailed mathematical model of the fluid mechanical and thermodynamic processes occurring during oscillation. A positive-feedback simulation model is postulated that demonstrates, for the first time, physically why there is an onset of oscillations and subsequent sustained motion. This model is based on actual observations of the startup process in a prototype pump. The initially reported thermodynamic efficiency of this heat engine was less than 0.3 percent. Currently, Fluidyne pumps have demonstrated efficiencies of about 2 percent. The peak efficiencies, however, may theoretically approach 10 percent. The mathematical model has shown that large losses occur in the heat transfer to the working gas, heat losses to the displacer liquid and friction in the output line. Improvements in these areas may dramatically improve the observed overall efficiency. The efficiency of the cycle itself, that is, the work done by the thermodynamic cycle relative to the output work, is on the order of 10 percent. GRA

**N79-29524# Barber-Nichols Engineering Co., Arvada, Colo  
TECHNOLOGY ASSESSMENT OF GEOTHERMAL PUMPING  
EQUIPMENT Final Report, Jul 1978**

Kenneth E. Nichols and A. J. Maligni. Sep 1978. 88 p. refs.  
(Contract EG-77-C-04-4162)  
(ALO-4162-2) Avail NTIS HC A05/MF A01

Interviews were conducted with DOE personnel, DOE contractors doing geothermal research, persons associated with geothermal installations, companies engaged in the drilling and completion of geothermal wells, and pump manufacturers. The reports of these interviews are presented and summarized and conclusions are drawn. DOE

**N79-29566 Oregon Univ., Eugene  
WATER AND ENERGY RESOURCE DEVELOPMENT IN THE  
TONGUE RIVER BASIN, SOUTHEASTERN MONTANA  
Ph.D. Thesis**

David Hunter Hickcox. 1979. 383 p.  
Avail Univ. Microfilms. Order No. 7918722

Water use, water availability, and energy development from the perspective of historical-cultural geography, physical geography, and resource management are examined. Water has been the key to the settlement and economy of the Tongue River Basin and is the key to future development of the basin. Massive development of the basin's coal resources which can alter the basin's hydrologic systems and traditional means of livelihood are discussed. Dissert. Abstr.

**N79-29575# Pullman Kellogg, Houston, Tex  
SOURCES AND DELIVERY OF CARBON DIOXIDE FOR  
ENHANCED OIL RECOVERY Final Report, Oct 1977 - Dec 1978**

M. Hare, H. Perlich, R. Robinson, M. Shah and F. Zimmerman.  
Dec 1978. 398 p. refs.  
(Contract EX-76-C-01-2515)  
(FE-2515-24) Avail NTIS HC A17/MF A01

The carbon dioxide supply situation for miscible flooding operations to enhance oil recovery (EOR) is presented. The carbon dioxide sources within the geographic areas of potential EOR are shown on four regional maps with the tabular data for each region describing the sources in terms of quantity and quality. Evaluation of all the costs, such as purchase, production, processing, and transportation, associated with delivering the carbon dioxide from its source to its destination are presented. DOE

**N79-29576# Mathematica, Inc., Princeton, N. J  
OIL SHALE. REPORT ON A FOCUS GROUP DISCUSSION**

G. R. Christophersen. 10 Nov 1978. 47 p. refs.  
(Contract EV-78-C-01-6388)

(DOE/TIC-10032) Avail NTIS HC A03/MF A01

The panel discussion focused on four types of barriers to oil shale commercialization including technological, economic, institutional, and environmental. The discussants agreed that both the size and potential demand for syncrude are massive. It was agreed that if this nation is to develop a domestic industry which is to produce liquid hydrocarbons as an energy source, the commercialization of the oil shale industry is important. Oil shale is viewed as the most economical option for domestic syncrude. Industry representatives share a strong optimism that an environmentally acceptable technology can be developed that will be economically attractive to industry. The environmentalists are concerned that as of yet no such environmentally acceptable technology exists. DOE

**N79-29577# Mathematica, Inc., Princeton, N. J  
ENHANCED OIL RECOVERY. REPORT ON A FOCUS  
GROUP DISCUSSION**

Irving Crespi. 10 Nov 1978. 40 p. refs.  
(Contract EV-78-C-01-6388)

(DOE/TIC-10021) Avail NTIS HC A03/MF A01

A qualitative assessment is presented of the dimensions of opinion concerning the commercialization potential of enhanced oil recovery. There was a group consensus that commercialization of EOR is contingent on the existence of financial incentives, primarily in the form of prices which will make EOR attractive for capital investment. A second prerequisite is loan guarantees to reduce the risk inherent in technologies that are still in the process of being developed. It was felt that tax credits would be an effective incentive. Current price regulations, and what appears to be a trend of DOE to resolve issues case by case rather than through standard rules, were considered to be disincentives to commercialization. DOE

**N79-29578# Market Facts, Inc., Washington, D. C.  
ENHANCE OIL RECOVERY. FOCUS GROUP RESULTS**

Aug 1978. 37 p. refs.

(Contract EV-78-C-01-6458)

(DOE/TIC-100200) Avail NTIS HC A03/MF A01

The research on the evaluation of the potential for commercialization of enhanced oil recovery, determination of the barriers to development of this resource, and evaluation of actions required by the federal government to promote commercialization are presented. Group agreement with the DOE assessment of EOR with some reasonably predictable difference in emphasis is reported. It was felt that price controls placed a particularly heavy burden on EOR not only because of the disincentive effect of the (then) current price (since the meeting the ERA has recommended a higher price for EOR oil), but because of the dislocation caused by two-tier pricing. DOE

**N79-29579# Gruy Federal, Inc., Houston, Tex  
ASSESSMENT OF POTENTIAL INCREASED OIL PRODUCTION BY POLYMER-WATERFLOOD IN NORTHERN AND SOUTHERN MID-CONTINENT OIL FIELDS Progress Report, period ending 30 Sep. 1978**

15 Oct 1978. 34 p. refs.

(Contract EW-78-C-19-0026)

(BETC-0026/4) Avail NTIS HC A03/MF A01

Results of polymer-waterflood studies are reported. The Burbank-Bartlesville sand reservoir, located in the north half of the Stanley Stringer Field, Osage County, Oklahoma was studied. Progress is summarized in a chart. DOE

**N79-29584# Technicolor Graphic Services, Inc., Sioux Falls, S. Dak  
A SELECTED BIBLIOGRAPHY. REMOTE SENSING  
TECHNIQUES FOR EVALUATING THE EFFECTS OF  
SURFACE MINING**

David M. Carnegie and Donald O. Ohlen. 6 Mar 1979. 15 p. refs.

(Contract DI-14-08-0001-16439)

(PB-294299/3) Avail NTIS HC A02/MF A01 CSCL 081

Thirty-one citations of technical papers and other publications dealing with the monitoring surface mining are presented. These references summarize recent developments in methods used to identify, map, analyze, and monitor surface mining, particularly coal surface mining. GRA

**N79-29592** Emory Univ., Atlanta, Ga.  
**URBAN AREAS AS ENERGY FLOW SYSTEMS**  
Ph.D. Thesis

Arwood James Ruttenber, Jr. 1979 371 p

Avail Univ Microfilms Order No 7916058

The application of energy flow analysis to the study of urban dynamics is evaluated from both theoretical and methodological perspectives. The paradigm of energy flow is discussed in terms of its relevance to the fields of theoretical biology, systems ecology, cultural anthropology, evolutionism, regional planning theory, and general system theory. An energy flow modeling technique is described and compared with other modeling approaches. A detailed explanation of the computer simulation of energy flow models is also provided. Dissert Abstr

**N79-29593** Wisconsin Univ. - Madison  
**AN ASSESSMENT OF WIND CHARACTERISTICS AND WIND ENERGY SYSTEMS APPLICATIONS TO ELECTRIC UTILITIES IN WISCONSIN AND SECTIONS OF MINNESOTA, IOWA AND ILLINOIS** Ph.D. Thesis

Carel Christiaan Dewinkel 1978 313 p

Avail Univ Microfilms Order No 7902397

Wind speed data from the National Climatic Center were analyzed to assess the wind characteristics for the application of wind energy conversion systems (WECS) to electric utility. In addition, five Coast Guard Stations along the shores of Lakes Superior and Michigan were analyzed. WECS as part of an electric utility system can be evaluated by electric utility planning methods. The method of analysis employs predicted wind power output data based on 5 years of wind speed observations, that are subtracted on an hourly basis from the predicted load levels. These adjusted hourly load levels serve as an input of a conventional production cost model. Savings in production costs over the lifetime of the WECS minus the O & M, taxes and insurance costs of the WECS result in the estimated break even capital cost of the WECS. Dissert Abstr

**N79-29594** Virginia Univ., Charlottesville  
**THE USE OF CHLOROPHYLL IN A NOVEL SOLAR BATTERY**  
Ph.D. Thesis

James Christopher Ludlow 1978 85 p

Avail Univ Microfilms Order No 7916266

A novel solar battery was developed, one which uses chlorophyll a for the generation of a current. The battery consisted of a platinum foil electrode, onto which a mixture of chlorophyll a and lipoic acid was deposited, and a platinum current collector. With such a device, voltages greater than 0.35 volts were reproducibly developed. The dependence of the output of the cell as a function of chlorophyll levels, carotenoid levels, and intensity and wavelength of the incident light was determined. It is felt that this solar cell which, in essence, mimics the action of the green leaf offers promise as a photovoltaic device. Dissert Abstr

**N79-29595** Washington Univ., Seattle  
**A CONTROL SYSTEM ANALYSIS OF THE ENERGY GROWTH MODEL: COAL** Ph.D. Thesis

Ole Arvid Bakken 1978 357 p

Avail Univ Microfilms Order No 7917535

The application of optimal control theory to allow for maximum use of solar power, in concert with coal and nuclear for the generation of electricity beyond 1990, with oil and gas having been phased out by 1990 is described and demonstrated. The literature search for a model resulted in the selection of the Dartmouth College model termed COAL. The model equations, written in DYNAMO simulation language and illustrated by DYNAMO diagrams are studied in detail, and then transformed

into differential equations with associated flow diagrams. The electricity generation sector and the demand sector of this model including a solar sector developed, are selected for detailed control system analysis. Three options for generating future electricity by solar are discussed, and numerical parameters for one option are incorporated into the computer simulation programs. Dissert Abstr

**N79-29596** Commission of the European Communities, Brussels (Belgium)  
**ENERGY RESEARCH AND DEVELOPMENT PROGRAMME**  
First Status Report, 1975 - 1976

Jul 1977 389 p

(EUR-5889, ISBN-9-024-72059-1) Copyright Avail Issuing Activity

Details of work carried out under contract and within the scope of the research and development program adopted by the council of Ministers of the European Community on August 22, 1975, are presented. Headings under which individual projects are grouped include Energy Conversion, Production and Utilization of Hydrogen, Solar Energy, Geothermal Energy, and 'Systems Analysis' (development of models). Author (ESA)

**N79-29597#** Committee on Energy and Natural Resources (U.S. Senate)

**ENERGY CONSERVATION AND REGULATION IN THE PRESIDENT'S BUDGET**

Washington, GPO 1978 399 p refs. Hearing before the Subcomm. on Energy Conservation and Regulation of the Comm. on Energy and Natural Resources, 95th Congr., 2d Sess., 3 Mar 1978.

(GPO-25-418, Publ-95-139) Avail Subcommittee on Energy Conservation and Regulation

The potential impact of the enactment of the National Energy Act on the manpower and budget requirements of the Department of Energy is examined. Funding for programs under the Assistant Secretary for Conservation and Solar Applications, the Economic Regulatory Administration, the Federal Energy Regulatory Commission, the Energy Information Administration, and the Director of Information is examined in testimony delivered and in written answers to specific questions supplied by members of the Committee. A R H

**N79-29598#** Motorola, Inc., Phoenix, Ariz.  
**SEMICONDUCTOR GRADE, SOLAR SILICON PURIFICATION PROJECT** Final Report, Feb 1976 - Jan 1979

W M Ingle, R S Rosler, S W Thompson, and R E Chaney. Jan 1979 173 p refs. Prepared for NASA and DOE.

(Contract JPL-954442)

(NASA-CR-158868, Rept-2257/12, DOE/JPL-954442-78/12)

Avail NTIS HC A08/MF A01 CSCL 10A

A low cost by-product SiF<sub>4</sub> is reacted with mg silicon to form SiF<sub>2</sub> gas which is polymerized. The (SiF<sub>2</sub>)<sub>x</sub> polymer is heated forming volatile SiF<sub>4</sub> homologues which disproportionate on a silicon particle bed forming silicon and SiF<sub>4</sub>. The silicon analysis procedure relied heavily on mass spectroscopic and emission spectroscopic analysis. These analyses demonstrated that major purification had occurred and some samples were indistinguishable from semiconductor grade silicon (except possibly for phosphorus). However, electrical analysis via crystal growth reveal that the product contains compensated phosphorus and boron. A W H

**N79-29599#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

**DYNAMIC ANALYSIS OF A PHOTOVOLTAIC POWER SYSTEM WITH BATTERY STORAGE CAPABILITY** Final Report

Walter C Merrill, Ronald J Blaha, and Roy L Pickrell. Jul 1979 47 p ref.

(DE-A101-79ET20485)

(NASA-TM-79209, E-094, DOE/NASA/20485-79/4) Avail NTIS HC A03/MF A01 CSCL 10C

A photovoltaic power system with a battery storage capability is analyzed. A dual battery current control concept is proposed which enables the battery to either supply or accept power.

depending upon system environment and load conditions. A simulation of the power system, including the battery current control, is developed and evaluated. The evaluation demonstrates the viability of the battery control concept of switch the battery from a charge to discharge mode and back as required by load and environmental conditions. An acceptable system operation is demonstrated over the entire insolation range. Additionally, system sensitivity, bandwidth, and damping characteristics of the battery control are shown to be acceptable for a projected hardware implementation. Author

**N79-29601\*#** Wyle Labs, Inc., Huntsville, Ala  
**LONG-TERM WEATHERING EFFECTS ON THE THERMAL PERFORMANCE OF THE SOLARGENICS (LIQUID) SOLAR COLLECTOR AT OUTDOOR CONDITIONS**

Jul 1979 13 p refs Prepared for DOE  
 (Contract NAS8-32036)  
 (NASA-CR-150523, TR-531-28-Add) Avail NTIS  
 HC A02/MF A01 CSDL 10A

The test procedures and the results obtained during the evaluation of a single-covered liquid solar collector are presented. The tests were performed under outdoor natural conditions. The collector was under stagnation conditions for a total of approximately ten months. The solar collector is a liquid, single-glazed, flat plate collector, and is about 240 inches long, and 38 inches in depth. K L

**N79-29602\*#** Wilson and Co., Salina, Kans  
**SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT SOUTHEAST OF SALINE, UNIFIED SCHOOL DISTRICT 308, MENTOR, KANSAS**

Jul 1979 119 p Prepared for NASA and DOE  
 (Contract EG-77-A-01-4077)  
 (NASA-CR-161271) Avail NTIS HC A06/MF A01 CSDL 10A

The solar system, installed in a new building, was designed to provide 52 percent of the estimated annual space heating load and 84 percent of the estimated annual potable hot water requirement. The liquid flat plate collectors are ground-mounted and cover a total area of 5125 square feet. The system will provide supplemental heat for the school's closed-loop water-to-air heat pump system and domestic hot water. The storage medium is water inside steel tanks with a capacity of 11,828 gallons for space heating and 1,600 gallons for domestic hot water. The solar heating facility is described and drawings are presented of the completed system which was declared operational in September 1978, and has functioned successfully since. A R H

**N79-29604\*#** Energy Research Corp., Danbury, Conn  
**TECHNOLOGY DEVELOPMENT FOR PHOSPHORIC ACID FUEL CELL POWERPLANT, PHASE 2 Quarterly Report**

Larry Christner Mar 1979 50 p refs Prepared for NASA and DOE  
 (Contract DEN3-67)  
 (NASA-CR-159572, DOE/NASA/0067-79/1) Avail NTIS  
 HC A03/MF A01 CSDL 10B

Component development has resulted in routine molding of 12 in by 17 in bipolar plates with 80 percent acceptance. A 5 C per hour post-cure heating cycle for these plates was found to give blister free materials. Lowering the resin in a bipolar plate content from 32 percent to 22 percent decreases the resistivity more than 50 percent. Evaluation of the corrosion resistance of Novolak and Resol resins at 185 C in phosphoric acid indicates a slow etch. Aresol modified phenolics however, decompose rapidly. Estimates of acid loss by the use of analytical expressions known as Margule, van Laar, and Wilson equations were not satisfactory. Experimental evaluation of the P4O10 vapor concentration of 103 wt percent acid at 191 C provided a value of 2 ppm. This value is based on a single experiment. Author

**N79-29605#** Resource Planning Associates Inc., Washington, D C  
**EUROPEAN WASTE-TO-ENERGY SYSTEMS CASE STUDY OF RENNES, FRANCE**  
 Sep 1978 45 p ref

(Contract EC-77-C-01-2103)  
 (HCP/M2103-0008) Avail NTIS HC A03/MF A01

The Rennes waste-to-energy unit is described. The unit, which burns the municipal solid waste of the city and 26 surrounding small communities, is connected to the district heating network. Along with an oil-fired heating plant, the Rennes combustion unit provides space heating and domestic hot water for nearly 5 000 housing units, hospital buildings, university dormitories and other institutional and commercial buildings. The sale of energy recovered from municipal solid waste more than pays for the operation of the combustion unit. The collection of waste, the design and operation of the system, and the cost of the system are discussed in detail. R E S

**N79-29606\*#** North Carolina State Univ., Raleigh Solid State Electronics Lab

**A THEORETICAL ANALYSIS OF THE CURRENT-VOLTAGE CHARACTERISTICS OF SOLAR CELLS Final Report**  
 R C Y Fang and J R Hauser Jan 1979 334 p refs  
 (Grant NGR-34-002-195)  
 (NASA-CR-158872) Avail NTIS HC A15/MF A01 CSDL 10A

The following topics are discussed: (1) dark current-voltage characteristics of solar cells, (2) high efficiency silicon solar cells, (3) short circuit current density as a function of temperature and the radiation intensity, (4) Keldysh-Franz effects and silicon solar cells, (5) thin silicon solar cells, (6) optimum solar cell designs for concentrated sunlight, (7) nonuniform illumination effects of a solar cell, and (8) high-low junction emitter solar cells. G Y

**N79-29607\*#** RCA Labs., Princeton, N J  
**AUTOMATED ARRAY ASSEMBLY, PHASE 2 Interim Report**  
 R V DiAello Jan 1979 136 p refs Prepared for JPL and DOE

(Contracts NAS7-100, JPL-954868)  
 (NASA-CR-158874, DOE/JPL-954868-79/1) Avail NTIS  
 HC A07/MF A01 CSDL 10A

A manufacturing process suitable for the large-scale production of silicon solar array modules at a cost of less than \$500/peak kW is described. Factors which control the efficiency of ion implanted silicon solar cells, screen-printed thick film metallization, spray-on antireflection coating process, and panel assembly are discussed. Conclusions regarding technological readiness or cost effectiveness of individual process steps are presented. J M S

**N79-29608\*#** National Aeronautics and Space Administration Langley Research Center, Hampton, Va

**SOLAR ENGINE Patent Application**  
 Ronald N Jensen, inventor (to NASA) Filed 22 Jun 1979 12 p  
 (NASA-Case-LAR-12148-1, US-Patent-Appl-SN-051275) Avail NTIS HC A02/MF A01 CSDL 10B

A solar engine is disclosed in which a fluid, which is first heated and then cooled, forces a piston outward as the fluid is heated and then draws inward as the fluid is cooled. The piston is connected to a shaft and produces work as it moves outward and inward. A displacer plate moves between an absorber plate and a cooling plate to form an air space between the displacer and one or the other of these two plates for heating and cooling the fluid. The displacer plate is for heating and cooling the fluid. The displacer plate is moved from one plate to the other by the displacer push ring as the piston nears the midpoint of its travel on the outward stroke and again on the inward stroke. NASA

**N79-29609#** Committee on Government Operations (U S House)

**SOLAR ENERGY**  
 Washington GPO 1979 634 p refs Hearings before a Subcomm of the Comm on Government Operations 95th Congr., 2d Sess., 12 May, 12-14 Jun 1978  
 (GPO-36-957) Avail Comm on Government Operations

A general overview of the status of solar energy technology in the United States is given with emphasis on the state of



California Solar collectors, photovoltaics as well as biomass conversion and other less direct, but solar based technologies are discussed Demonstration projects, in industrial as well as residential buildings, are included Program goals, incentives, projected energy savings, and cost factors are among the factors considered JMS

**N79-29612#** Gulton Industries, Inc., Hawthorne, Calif Engineered Magnetics Div  
**DEVELOPMENT PROGRAM FOR 3.0 KW INVERTER: MILITARIZED INVERTER FOR USE WITH FUEL CELL OR BATTERY POWER PLANTS** Final Report, Dec. 1976 - Dec. 1978

John E Rance 15 Jan 1979 24 p

(Contract DAAK70-77-C-0012)

(AD-A068433) Avail NTIS HC A02/MF A01 CSCL 10/2

This report describes the design, construction and testing of a static inverter rated at 30 kilowatts Circuit techniques were evaluated to obtain desired results with considerations to cost, reliability, maintainability, weight, size and efficiency The application of this portable, rugged inverter is to replace mechanical alternating generators used in the field GRA

**N79-29614#** Tetra Tech, Inc., Arlington, Va  
**DEPARTMENT OF THE NAVY ENERGY FACT BOOK**

May 1979 520 p refs

(Contract N00014-78-C-0434)

(AD-A069138, TETRA-T-A-6054-403) Avail NTIS HC A22/MF A01 CSCL 10/2

The Department of the Navy Energy Fact Book presents the U.S., including the DoD and Navy, energy situation, summarizes Navy energy R and D initiatives provides an in-depth description of the various processes and developments related to hydrocarbon fuels, synthetic fuels, non-hydrocarbon energy sources, and energy conversion, and briefly describes energy R and D legislation and cooperative energy programs GRA

**N79-29615#** Coast Guard Research and Development Center, Groton, Conn

**ECONOMIC ANALYSIS OF SOLAR PHOTOVOLTAICS FOR LOW-POWER LIGHTED AIDS TO NAVIGATION** Final Report

William R Allen Jun 1978 53 p refs

(AD-A068365, CGR/DC-11/78, USCG-D-23-79) Avail NTIS HC A04/MF A01 CSCL 20/1

A detailed economic analysis with decision-making criteria for converting the present energy storage system used on U.S. Coast Guard low-power lighted aids to navigation to one that relies upon conversion of solar energy by photovoltaics is presented The analysis demonstrates that converting 12-volt lighted aids to navigation from reliance on primary air-cell batteries to reliance on solar photovoltaics is attractive from an economic point of view However, questions concerning reliability and life must be answered before the Coast Guard plans conversion to solar photovoltaics GRA

**N79-29616#** IIT Research Inst., Chicago, Ill  
**HYDROGEN GENERATOR SUBSYSTEM: CATALYST AND EQUIPMENT DEVELOPMENT FOR THERMO-CATALYTIC CRACKER** Final Technical Report

R Henry Nov 1978 106 p refs

(Contract DAAG53-76-C-0081, DA Proj 1L2-63701-DG-10)

(AD-A068452, IITRI-C6363-33) Avail NTIS HC A06/MF A01 CSCL 10/2

Future Army plans call for generation of silent electrical power in field situations Hydrogen/air fuel cells are considered viable electrical power generators Currently available logistic fuels are hydrocarbon, requiring a fuel conditioning process to free hydrogen for use by the fuel cell This report concerns one such process to obtain hydrogen from hydrocarbon fuels Experimental work is aimed at optimizing a catalyst for catalytic cracking and the development of a breadboard hydrogen generator Further work is needed in both these areas GRA

**N79-29617#** Michigan State Univ., East Lansing  
**SMALL LOW-HEAD HYDROELECTRIC POWER**

O Krauss Aug 1978 495 p refs Presented at Midwest Regional Conf., East Lansing, Mich 23 May 1978

(Contract ET-78-S-07-1732)

(IDO-10076, Conf-7805120) Avail NTIS HC A21/MF A01

The rehabilitation of abandoned hydro sites and generation of power at dams which were constructed for nonpower purposes which could add to the supply of electric energy is presented Such development near the sites could aid local economies Multipurpose uses were considered Major economic and/or institutional problems were delineated DOE

**N79-29620#** Department of Energy, Washington, D C Div of Solar Technology

**GUIDE TO SOLAR ENERGY PROGRAMS**

Jun 1978 75 p refs

(DOE/ET-0036/1) Avail NTIS HC A04/MF A01

The following are included Department of Energy mission and objectives, overview of the Department of Energy's solar energy programs, program activities and structure, solar energy programs now functioning under the Division of Conversion and Solar Applications, methods of procurement and guides for proposal preparation, and sources of solar energy information and activities supporting the solar energy program Author (DOE)

**N79-29621#** Battelle Pacific Northwest Labs., Richland, Wash  
**ROLE OF GOVERNMENT IN SOLAR ENERGY DEVELOPMENT: A VIEW FROM THE NORTHWEST**

Jill A Goodnight and Sarah T King Aug 1978 181 p refs

(Contract EY-76-C-06-1830)

(PNL-2784) Avail NTIS HC A09/MF A01

Several economic feasibility studies of solar heating in the Northwest are described The case for federal assistance to the solar industry and the consumer is developed The solar related activities undertaken by the Northwest states of Oregon, Idaho, Washington, and Montana are detailed Finally roles are addressed which municipal government may play either to encourage or to deter the widespread use of solar heating systems DOE

**N79-29622#** Brown Univ., Providence, R I Div of Engineering

**GEOHERMAL POWER PLANTS OF NEW ZEALAND, PHILIPPINES, AND INDONESIA: A TECHNICAL SURVEY OF EXISTING AND PLANNED INSTALLATIONS**

Ronald DiPippo Jun 1978 123 p refs

(Contract EY-76-S-02-4051)

(COO-4051-23, CATMET/17) Avail NTIS HC A06/MF A01

Geothermal power plants in the south Pacific area were surveyed including New Zealand, the Philippines and Indonesia The geologic characteristics of the fields are described along with wellflow particulars, energy conversion systems, environmental impacts, economic factors and operating experiences, where available The geothermal resource utilization efficiency is computed or estimated for the power plants covered Furthermore, some discussion is devoted to the other sites which may prove exploitable for the production of electricity DOE

**N79-29623#** Market Facts, Inc., Washington, D C  
**LARGE WIND ENERGY FOCUS GROUP RESULTS**

Aug 1978 35 p

(Contract EY-78-C-01-6456)

(DOE/TIC-10038) Avail NTIS HC A03/MF A01

A report is presented of the focus group research on large wind energy systems prepared for the Department of Energy as part of the commercialization program The potential for commercialization of wind energy is evaluated to determine the barriers to development of this resource, and to judge what actions are required by the Federal Government to promote commercialization The issues of commercialization as examined by a focus group consisting of key individuals from various organizations involved in large wind energy systems development are discussed DOE

**N79-29624#** Kernforschungsanlage, Juelich (West Germany)  
**Programmgruppe Systemforschung und Technologische Entwicklung**

**POSSIBILITIES AND LIMITATIONS OF SOLAR ENERGY UTILIZATION WITH THE USE OF LOW-TEMPERATURE COLLECTORS IN THE GERMAN FEDERAL REPUBLIC PRINCIPLES, ENGINEERING SYSTEMS, ECONOMY**

M Melib Dec 1978 247 p refs In GERMAN, ENGLISH abstract

(Juel-Spez-25, ISSN-0313-7639) Avail NTIS (US Sales Only) HC A11/MF A01, DOE Depository Libraries

Technical performance and economy of low-temperature solar collector systems are investigated with regard to their possible application for the LT-heat supply in the FRG. The systems consist of a flat plate collector system, including storage and a conventional back-up system and may be assisted by an electrically driven heat pump. The analysis is carried out by computer simulation based on a mathematical model of the different kinds of LT-system-components. The separate modelling of collector heat exchanger storage facility heat pump etc makes the various composition of components possible. Four types of LT-collector systems are investigated: domestic hot water supply system, house heating system, combined house heating and hot water supply system, and solar assisted heat pumps for heating and hot water supply. Simulations are based upon hourly data of total insolation and ambient temperature measured at Hamburg and Munich. DOE

**N79-29625# Lincoln Lab Mass Inst of Tech Lexington PHASE-ONE EXPERIMENT TEST PLAN SOLAR PHOTOVOLTAIC/THERMAL RESIDENTIAL EXPERIMENT**

Edward C Kern Jr 15 Mar 1979 16 p refs

(Contract EG-77-S-02-4577)

(COO-4577-6) Avail NTIS HC A02/MF A01

Objectives, rationale and method of a one-year experiment using a residential photovoltaic/thermal power system are presented. Data archived and processed to investigate (1) series heat pump system performance, and (2) electric utility impacts. A parallel heat pump system is investigated in a subsequent experiment. DOE

**N79-29627# Lincoln Lab Mass Inst of Tech Lexington PHOTOVOLTAIC POWER SYSTEM FIELD TESTS**

M D Pope and R W Matlin Jun 1978 9 p refs Presented at IEEE Photovoltaic Specialists Conf Washington D C 5 Jun 1978

(Contract EY-76-C-02-4094)

(COO-4094-15 Conf-780619-20)

Avail NTIS HC A02/MF A01

The systems discussed are photovoltaic (PV) agricultural testing which includes the existing 25 kW peak system as well as on-going development of very small microirrigation systems consuming less than 1 kW peak, a 16 kW system, the Lincoln PV system test facility at Lexington Massachusetts, four real-time endurance test sites located in the northeast, the Natural Bridges 100 kW PV power system, and a 20 kW PV power system for one AM radio station. The latter two systems are presently being designed. Experience gained from these projects is discussed in the contexts of storage system reliability and safety, efficiency implications and costs of PV structural and foundation elements. DOE

**N79-29630# Oak Ridge National Lab Tenn ELECTRICITY IN LIEU OF NATURAL GAS AND OIL FOR INDUSTRIAL THERMAL ENERGY A PRELIMINARY SURVEY**

J R Tallackson Feb 1979 126 p refs

(Contract W-7405-eng-26)

(ORNL/TM-5937) Avail NTIS HC A07/MF A01

The capability of the process industries to substitute utility-generated electricity for natural gas and oil is assessed. It is concluded that the existing technology will permit substitution of electricity for approximately 75% of the natural gas and petroleum now being consumed by industrial processors. Process steam generation representing 40% of its energy usage offers the best near-term potential for conversion to electricity. Electric boilers and energy costs for steam are briefly discussed. Electrically driven heat pumps are considered as a possible method to save additional low-grade energy. Electrical reheating at high

temperatures in the primary metals sector will be in effective way to conserve gas and oil. A wholesale shift by industry to electricity to replace gas and oil will produce impacts on the public utilities. The principal bar to large-scale electrical substitution is economics, not technology. DOE

**N79-29631# Westinghouse Electric Corp East Pittsburgh Pa Advanced Systems Technology Div**

**METHODOLOGY FOR SOLAR-THERMAL POWER PLANT EVALUATION**

J T Day Aug 1978 129 p refs Sponsored by Elec Power Res Inst

(EPRI Proj 648-1)

(EPRI-ER-869) Avail NTIS HC A07/MF A01

The development of an evaluation methodology including process for evaluating solar thermal plant impact on utility reliability and margin requirements and economics, plus the impact of solar plant penetration is presented. In addition to a general methodological framework, specific methods covered include a specific economic calculation methodology, a process for modeling the interdependent operation of a solar plant and the balance of the utility system, a procedure for reserve margin analysis and a method for solar plant penetration analysis. DOE

**N79-29633# Dunham Associates Inc Bismarck N Dak BISMARCK, NORTH DAKOTA, OFFICE COMMERCIAL SOLAR DEMONSTRATION DESIGN AND CONSTRUCTION REPORT**

5 Jan 1979 25 p

(Contract EG-77-C-02-4228)

(COO-4228-1) Avail NTIS HC A02/MF A01

The demonstration consisted of adding 5000 square feet of flat plate collector to an existing four story 75,000 square feet office building. The existing mechanical system is an electric water to water heat pump system with 60,000 gallons of thermal storage. The retrofit design converted one 20,000 gallon tank for use as solar storage and added the 5000 square feet of double glazed, selective surface flat plate collector. The solar collector is mounted as a ground mounted array which is stepped down a hillside. The array is expected to provide 1944 million BTU of useable energy annually. That energy is equivalent to 34% of the building heating energy. DOE

**N79-29634# Los Alamos Scientific Lab N Mex Systems, Analysis and Assessment Div**

**TROMBE WALLS AND DIRECT GAIN PATTERNS OF NATIONWIDE APPLICABILITY**

Scott A Noll J Fred Roach and Shaul Ben-David (New Mex Univ Albuquerque) 1979 9 p refs Presented at 3d Natl Passive Solar Conf San Jose 11-13 Jan 1979

(Contract W-7405-eng-36)

(LA-UR-79-239 Conf-790106-5)

Avail NTIS HC A02/MF A01

The economic performance of Trombe wall and direct gain passive solar heating designs are evaluated on a nationwide basis using the LASL/UNM solar economic performance code. Both designs are integrated into a ranch style tract home concept thereby facilitating regional comparisons. Solar add-on costs are established for each design with regional differences in material and labor prices accounted for at each site. System sizes are optimized against the natural gas and electric resistance heating alternatives, the current price and future escalation of which is established for each locale. Results for each passive solar design are summarized on a state-by-state basis followed by a discussion of their comparative economic performance. DOE

**N79-29635# Solar Systems of Virginia, Inc Hampton COST EFFECTIVE SOLAR HOT WATER SYSTEM FOR ECONO-TRAVEL MOTOR HOTEL LOCATED AT WOODBRIDGE, VIRGINIA Final Report**

Nov 1978 18 p

(Grant EM-78-G-02-4661)

(COO-4661-1) Avail NTIS HC A02/MF A01

The description of the system presented along with the final breakdown performance data and payback time are given. The payback time for the installed system is approximately four years.

instead of the 7 2 years estimated for the proposal. The additional savings is due to the reduction in the peak demand charge since the electric hot water heaters are not required to operate at the same time each morning as the dryers used for the laundry. As called for in the proposal to DOE the success of the system is determined by the reduction in the utility cost and reduced use of our fossil fuels. The lower hotel's monthly electricity bills indicate that this goal was accomplished. DOE

**N79-29636# Argonne National Lab III Solar Energy Group DESIGN AND INSTALLATION MANUAL FOR THERMAL ENERGY STORAGE**

Roger L Cole ed Kenneth J Nield, ed Raymond R Rhode ed, and Ronald M Wolosewicz, ed Feb 1979 283 p refs (Contract W-31-109-eng-38)

(ANL-79-15) Avail NTIS HC A13/MF A01

Information on the design and installation of thermal energy storage in solar heating systems is provided. The manual presented includes sizing storage choosing a location for the storage device and insulation requirements. Both air-based and liquid-based systems are covered with topics on designing rock beds, tank types pump and fan selection, installation costs and operation and maintenance. Topics relevant to heating domestic water include safety single- and dual-tank systems, domestic water heating with air- and liquid-based space heating system, and stand-alone domestic hot water systems. DOE

**N79-29637# B and A Engineers Ltd, Chicago, Ill ASSESSMENT OF THE TECHNOECONOMIC FEASIBILITY OR SEASONAL THERMAL ENERGY STORAGE SYSTEMS (STES)**

Dec 1978 81 p refs (Contract W-31-109-eng-38)

(ANL/EES-TM-35) Avail NTIS HC A05/MF A01

The feasibility of the use of seasonal thermal energy storage systems employing large volumes of water is examined on the bases of technology and economics. Three building types are considered single-family houses, low-rise multi-family apartment buildings, and small commercial buildings. Construction costs are based on prevailing conditions in the suburban Chicago area marketplace. Various types of vessels above and below ground are considered along with possible vessel materials. DOE

**N79-29638# Brown Univ Providence, R I Engineering Div GEOTHERMAL POWER PLANTS OF MEXICO AND CENTRAL AMERICA A TECHNICAL SURVEY OF EXISTING AND PLANNED INSTALLATIONS**

Ronald DiPippo Jul 1978 103 p refs (Contract EY-76-S-02-4051)

(COO-4051-26) Avail NTIS HC A06/MF A01

The geothermal power plants of Mexico and Central America were studied. The geothermal plants are located in areas of recent and active volcanism the resources are of the liquid-dominated type. Details are given about the plants located at Cerro Prieto in Mexico and at Ahuachapan in El Salvador. In both cases attention is paid to the geologic nature of the fields, the well programs geofluid characteristics, energy conversion systems materials of construction effluent handling systems, economic factors and plant operating experience. Exploration and development activities are described for other promising geothermal areas in Mexico and El Salvador, along with those in the countries of Costa Rica, Nicaragua Guatemala, Honduras, and Panama. DOE

**N79-29639# Brown Univ Providence, R I Engineering Div INTRODUCTION TO ELECTRIC ENERGY CONVERSION SYSTEMS FOR GEOTHERMAL ENERGY RESOURCES**

Ronald DiPippo Jun 1978 21 p refs (Contract EY-76-S-02-4051)

(COO-4051-28) Avail NTIS HC A02/MF A01

The types of geothermal energy conversion systems in use are classified as follows direct, dry steam, separated steam, single-flash steam double-flash steam multi-flash steam, brine/Freon binary cycle, and brine/isobutane binary cycle. The thermodynamics of each of these is discussed with reference to

simplified flow diagrams. Typical existing power plants are identified for each type of system. DOE

**N79-29640# Applied Physics Lab Johns Hopkins Univ Laurel Md POTENTIAL APPLICATION OF MADISON FORMATION WATERS FOR COMMUNITY HEATING IN SOUTH DAKOTA**

R A Freeman and R F Meier Sep 1978 44 p refs (Contract EX-76-A-36-1008)

(APL/JHU/QM-78-042R) Avail NTIS HC A03/MF A01

The general design of such a community system is discussed along with its cost means of financing and life expectancy. Legal questions and state statutes that are pertinent are cited and the life expectancy of the entire Madison resource and equipment to exploit the resource are considered. DOE

**N79-29642# Pacific Gas and Electric Co San Francisco Calif IMPLICATIONS OF THE FUSION POWER SOURCE TO THE ELECTRIC UTILITY INDUSTRY**

Nov 1978 144 p refs Presented at EPRI Executive Seminar on Fusion, San Francisco, Calif, 11 Oct 1977

(Contract ES-77-G-05-5576)

(EPRI-ER-943-54, Conf-771071-Summ)

Avail NTIS

HC A07/MF A01

The viewpoints and plans of the utility industry and the fusion community with respect to thermonuclear power plants are examined. Basic background material concerning the fusion process is emphasized including the current status and future plans of the fusion research and development effort. DOE

**N79-29643# Ohio State Univ, Columbus WORKSHOP ON ENERGY SOURCES AND ELECTRIC POWER GENERATION FOR HIGH SCHOOL STUDENTS Final Report**

Donald D Glower and Herbert L Coon Sep 1978 345 p refs Workshop held at Columbus Ohio, 11-30 Jun 1978

(Contract EY-76-C-02-2449)

(TID-28975) Avail NTIS HC A15/MF A01

Workshop participants studied various aspects of the national energy problem and prepared instructional materials for use in their classrooms. Attention was given to short and long term resources available, to conversion systems, to economic, social and philosophical problems associated with energy production and use and the importance of conservation. The conversion steps involved in transforming uranium ore into electric power were examined through lectures, audio visual aids and extensive discussions. DOE

**N79-29645# Market Facts, Inc, Washington, D C LOW HEAD HYDROPOWER FOCUS GROUP RESULTS**

Aug 1978 32 p refs

(Contract EV-78-C-01-6458)

(DOE/TIC-10017) Avail NTIS HC A03/MF A01

The barriers and opportunities associated with the successful commercialization of low head hydropower and the appropriate Federal actions for promoting and facilitating commercialization of this technology were evaluated. The primary questions put before the discussion group participants were: is commercialization of low head hydropower feasible, what is the nature and extent of the market for this technology, what barriers and opportunities are critical to the commercialization of low head hydropower, and what actions if any should be taken by the Federal government to bring about successful commercialization of this technology. The opinions attitudes and knowledge of the participants on these issues are summarized. DOE

**N79-29647# International Research and Technology Corp, McLean Va TEN SCENARIOS OF TRANSPORTATION ENERGY CONSERVATION USING TECNET Final Report**

Ralph M Doggett, R Meyer, and M Heller Mar 1979 114 p refs

(Contract EX-76-C-01-2101)

(HCP/M2101-1) Avail NTIS HC A06/MF A01

The TECNET system was developed to provide DOE with the capability to measure the total energy consequences of alternative transportation strategies out to the year 2025. Ten scenarios were tested to obtain a wide array of policy alternatives, beginning with a Base Case scenario (business as usual). The other scenarios include a conservation scenario, scenarios with high penetration rates for alternative engine automobiles, a gas rationing scenario and a series of sensitivity analyses in which various parameters were altered to test their effects.

Author (DOE)

**N79-29648#** International Research and Technology Corp  
McLean, Va

**FURTHER DEVELOPMENT AND USE OF THE TRANSPORTATION ENERGY CONSERVATION NETWORK (TECNET)**

Ralph M. Doggett, A. Shapanka, R. Meyer, and R. Strieter. Mar 1979. 184 p. refs

(Contract EX-76-C-01-2101)

(HCP/M2101-2) Avail NTIS HC A09/MF A01

The TECNET model underwent a variety of changes and was used to assess the implications of many different patterns of future transportation demand. Its primary purpose is to estimate the total energy requirements of the transportation sector, under alternative assumptions of transportation trends, out to the year 2025. The model is unique in that it estimates both direct and indirect energy requirements of the transportation sector, within a comprehensive framework that includes a large input-output model for assessing economic impacts, the methodologies for estimating pollution emission from both mobile and stationary sources.

Author (DOE)

**N79-29649#** Midland-Ross Corp., Toledo, Ohio  
**RECUPERATIVE SYSTEM FOR HIGH AND ULTRA-HIGH TEMPERATURE FLUE GASES** Quarterly Report, Apr - Jun 1978

J. G. Reitz. 17 Jul 1978. 89 p. refs

(Contract EC-77-C-07-1672)

(IDO-1672-2) Avail NTIS HC A05/MF A01

Progress is reported in the development of a tile-metallic recuperative system for industrial application with flue gases in the 1200 to 1900 F temperature range. The selection of a steel soaking pit demonstration site is investigated, and design studies are included.

DOE

**N79-29650#** Gordian Associates, Inc., Washington, D. C.  
**ENERGY SUPPLY AND DEMAND BALANCES AND FINANCING REQUIREMENTS IN NON-OPEC DEVELOPING NATIONS** Final Report

Feb 1979. 178 p. refs

(Contract EH-77-C-01-6407)

(HCP/H6407) Avail NTIS HC A09/MF A01

The question of possible LDC (less developed countries) responses to energy shortages in three respects is addressed. First, energy conservation and fuel-switching alternatives are examined for industry, transportation, the urban residential sector, and the rural and agricultural sector. Second, small-scale technologies for renewable energy resources are discussed in terms of their potential applications for LDCs. Finally, each LDC country group's range of likely responses to energy shortages is examined in terms of both historical patterns and resource constraints.

DOE

**N79-29651#** General Electric Co., Philadelphia, Pa. Valley Forge Space Center

**REGIONAL CONCEPTUAL DESIGN AND ANALYSIS STUDIES FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS VOLUME 1 EXECUTIVE SUMMARY** Final Report

Jan 1979. 54 p. refs

(Contract EY-76-C-04-0789)

(SAND-78-7039) Avail NTIS HC A04/MF A01

A wide range of roof-mounted array systems was studied including PV-only systems and combined and separate PV/thermal collection systems which provide heat for space conditioning and domestic hot water. The attractiveness of the system options

were assessed in terms of performance and economic competitiveness based on hourly weather data for twelve designated regions of the US representing a broad spectrum of climatic characteristics. The study determined that if PV economic goals are achieved, PV-only solar energy systems for residential use should be emphasized because of their potential economic viability in all regions. On the basis of the costs and benefits used in the analysis, residential systems without batteries are preferred over systems with batteries assuming utility feedback acceptance at some differential buy-back rate such as 40 to 50% of the sell rate. Side-by-side PV/thermal systems become more viable across the nation with a PV system cost to thermal system cost ratio of 1.

DOE

**N79-29653#** Florestal Acesita, Belo Horizonte (Brazil)  
**SHORT NOTICE ON A GRAND FOREST TROPICAL LAND CONVERTING SUNLIGHT TO ENERGY**

[1978]. 20 p.

(NP-23278) Avail NTIS (US Sales Only) HC A02/MF A01, DOE Depository Libraries

The factors that make reforestation of a large area in Brazil feasible are presented. The trees planted are eucalyptus destined for the production of charcoal for steel making in the area.

DOE

**N79-29655#** Wisconsin Univ., Madison  
**SIMULATION AND DESIGN OF SOLAR THERMAL PROCESSES**

Dec 1978. 11 p.

(Contract EY-76-S-02-2588)

(COO-2588-2) Avail NTIS HC A02/MF A01

Process component model formulations were developed including transient LiBr-H<sub>2</sub>O absorption cooler, CPC and other 'advanced' collectors, and windows, storage wall and shading devices for passive solar heating. Systems studies included parallel and series solar/heat pump combinations, phase change storage in solar heating, absorption cooling with and without cooler transients. The general solar process simulation program, TRNSYS, was further developed, documented, distributed and supported. Design procedure studies led to development of a method for calculating the phi, the average solar radiation availability, and the development of the phi-f-chart method for design of closed-loop solar heating systems which can have load temperatures other than 20 C and have approximately constant COP of any energy converters between storage and load.

DOE

**N79-29656#** Pennsylvania Univ., Philadelphia. Dept. of Mechanical Engineering and Applied Mechanics  
**STANDARDS APPLICABLE TO PERFORMANCE MEASUREMENT OF SOLAR HEATING AND COOLING SYSTEMS**

Noam Lior. 1978. 8 p.

(Contract EG-77-S-02-4142)

(COO-4142-2) Conf-780432-4)

Avail NTIS

HC A02/MF A01

The advantage of the utilization of existing standards in the performance monitoring of solar heating and cooling systems is discussed. Existing applicable measurement standards and practices are listed.

DOE

**N79-29657#** Brookhaven National Lab., Upton, N. Y. Policy Analysis Div.

**SYSTEMS APPROACH TO ENERGY PLANNING**

Philip F. Palmedo and Robert Nathans. 18 Nov 1978. 21 p. refs. Presented at Caribbean Consultation on Energy and Agr., Santo Domingo, 1 Dec 1978.

(Contract EY-76-C-02-0016)

(BNL-25523) Conf-781226-1) Avail NTIS HC A02/MF A01

The criteria of successful energy planning and ways to go about such planning are outlined. Economic, social and political factors are discussed along with a wide range of geographical scales, from the household and village to the world scene. A reduced reliance on oil imports is emphasized.

DOE

**N79-29658#** Argonne National Lab , III Energy and Environment Systems Div  
**PROCEEDINGS OF THE 2ND WORKSHOP ON ENERGY-CONSERVING SITE DESIGN CASE STUDIES**  
 Robert Hrabak Jan 1979 111 p refs Proc held on 14-15 Sep 1978

(Contract W-31-109-eng-38)

(ANL/ICES-TM-22) Avail NTIS HC A06/MF A01

Various options for increasing energy conservation through building design are identified and evaluated. Design case studies discussed include Burke Center in Fairfax Co Virginia, Radisson in central New York Greenbrier in Virginia near Norfolk, Shenandoah in Georgia near Atlanta and the Woodlands in Texas near Houston. Technological progress for each development is summarized. An energy conservation system that collects heat in summer for winter heating and preserves the chill in winter for summer cooling is described. DOE

**N79-29659#** Argonne National Lab III Energy and Environmental Systems Div

**METHOD FOR THE PRELIMINARY FEASIBILITY ANALYSIS OF COMMUNITY ENERGY SYSTEMS**

Chinmei Lee Wayne P Pferdehirt, and Allen S Kennedy 1979 9 p refs Presented at 3d Natl Conf on Technol for Energy Conversion Tucson, Ariz 23-25 Jan 1979

(Contract W-31-109-eng-38)

(CONF-790107-5) Avail NTIS HC A02/MF A01

This analysis is provided as a tool to indicate whether, on the basis of potential economic benefits, the application of a community energy system to a specific site should receive additional investigation. Major elements of the analysis include, characterization of community energy demands, engineering design of the system, cost estimation and economic analysis. DOE

**N79-29660#** Philips Labs , Briarcliff Manor, New York  
**SYSTEM ANALYSIS, DESIGN AND PROOF-OF-CONCEPT EXPERIMENT OF A TOTAL ENERGY SYSTEM, PHASE 2**  
**Final Report, 16 Sep 1977 - 15 May 1978**

B Ziph Jul 1978 53 p refs

(Contract EY-76-C-02-2947)

(COO-2947-5) Avail NTIS HC A04/MF A01

Alternative candidate Stirling engine configurations for a 1000 kw prime mover were evaluated to determine the configuration showing the most desirable combination of pertinent characteristics. Both single-cylinder and multi-cylinder, and single-acting and double-acting configurations were considered. Having expressed all characteristics in terms of cost-ownership, the multi-cylinder (8), single-acting configuration was optimum. DOE

**N79-29661#** Argonne National Lab , III Transportation Energy Systems

**TRANSPORTATION ENERGY CONSERVATION- AN ENVIRONMENTAL OVERVIEW**

Martin J Bernard III Nov 1978 24 p refs Presented at DOE Environ Control Symp Washington D C, 28-30 Nov 1978

(Contract W-31-109-eng-38)

(CONF-781109-16) Avail NTIS HC A02/MF A01

The DOE environmental evaluation process designed to implement NEPA policies and guidance, is effective in addressing environmental concerns early in the development of a technology, strategy or policy and in projecting the research and assessment requirements necessary to resolve those concerns. The real success of DOE's method for NEPA implementation will not be known until environmentally and technologically sound transportation energy systems are available as a result of the RD and D efforts or useful policies are implemented. Assessment efforts completed to date focused on electric vehicles since they are about to be demonstrated and have uncovered some possible impacts requiring further study to understand them and to mitigate them. The process is systematic, comprehensively searches all environmental areas for concerns relating to Transportation Energy Conservation program elements, and rigorously assesses the impacts of those concerns. DOE

**N79-29662#** Logistics Management Inst Washington, D C  
**INTERNATIONAL ENERGY EVALUATION SYSTEM. VOLUME 1- EXECUTIVE SUMMARY**

M L Shaw and M J Hutzler Mar 1977 43 p ref

(Contract EC-77-C-01-8602)

(HCP/18602-01/1) Avail NTIS HC A03/MF A01

The following topics are discussed: the energy forecasting problem in general, the international energy evaluation system (IEES) forecasting method and how it is distinguished from other international energy forecasting systems, the major components of IEES, and the principal applications of IEES. IEES provides alternatives forecasts of energy prices, supplies, demands, and conversion activities. DOE

**N79-29663#** United Engineers and Constructors, Inc , Philadelphia, Pa

**TOTAL GENERATING COSTS COAL AND NUCLEAR PLANTS**

Feb 1979 227 p

(Contract EY-76-C-02-2477)

(NUREG-0248, COO-2477-12) Avail NTIS HC A11/MF A01

Single and multi-unit coal- and nuclear-fueled electric-generating solutions are described. The total generating cost estimates were developed for commercial operation dates of 1985 and 1990, for 5 and 8% escalation rates, for 10 and 12% discount rates, and, for capacity factors of 50, 60, 70, and 80%. The methodology for obtaining annualized capital costs, leveled coal and nuclear fuel costs, leveled operation and maintenance costs, and the resulting total generating costs for each type of station are reported. The costs are applicable to a hypothetical Middletown site in the Northeastern United States. Plant descriptions with general design parameters are included. The report reprints for convenience, summaries of capital cost by account type developed in the previous commercial electric-power cost studies. DOE

**N79-29664#** Main (Charles T), Inc Boston, Mass  
**UNDERGROUND HYDROELECTRIC PUMPED STORAGE: AN EVALUATION OF THE CONCEPT** Final Report

Nov 1978 354 p refs

(Contract EC-77-C-01-2133)

(TID-29412) Avail NTIS HC A16/MF A01

A contribution to the Bureau of Reclamation's Underground Hydroelectric Pumped Storage (UHPS) Program is presented. The state-of-the-art through research and developmental work was enhanced. The review consisted of an evaluation of the technical feasibility and economic viability of UHPS, identification for further research, and recommendation for a continuing program of development. DOE

**N79-29665#** California Univ , Livermore Lawrence Livermore Lab

**DOE/STOR BIBLIOGRAPHY FOR FLYWHEEL ENERGY SYSTEMS, 1977**

B Mallon and R W Kuhn 5 Jan 1979 330 p

(Contract W-7405-eng-48)

(UCRL-52637) Avail NTIS HC A15/MF A01

Five hundred and fifty-five selected references to the world literature through December 1977 are presented. It includes citations that describe flywheel designs, properties and materials, and the actual and contemplated applications of flywheels in vehicles, utilities, aircraft, and spacecraft. The citations are selectively grouped according to the subjects mentioned above and organized by author and by date. An alphabetical index of authors is presented as well as a listing of keyphrases organized by subject matter. An alphabetical listing of authors and keyphrases are reported. DOE

**N79-29666#** Los Alamos Scientific Lab , N Mex  
**NON-ELECTRICAL USES OF THERMAL ENERGY GENERATED IN THE PRODUCTION OF FISSION FUEL IN FISSION- FISSION REACTORS: A COMPARATIVE ECONOMIC PARAMETRIC ANALYSIS FOR HYBRID WITH OR WITHOUT SYNTHETIC FUEL PRODUCTION**

A S Iai and R A Krakowski 1979 19 p refs Presented at the 3rd US/USSR Symp on Fusion Fission Hybrids, Princeton NJ 22 Jan 1979

(Contract W-7405-eng-36)  
(LA-UR-79-574, Conf-790117) Avail NTIS  
HC A02/MF A01

The sensitivity of the synfuel production cost in relation to crucial economic and technologic quantities (investment costs of hybrid and synfuel plant, energy multiplication of the fission blanket, recirculating power friction of the fusion driver, etc) was analyzed parametrically. In addition, a minimum synfuel selling price was evaluated, from which the fission-fusion-synfuel complex brings about a higher economic benefit than does the fusion-fission hybrid entirely devoted to fissile fuel and electricity generation. Assuming an electricity cost of 2.7 cents/kWh, an annual investment cost per power unit of 4.2 to 6 \$/GJ for the fission-fusion complex and 1.5 to 3 \$/GJ for the synfuel plant, the synfuel production net cost varies between 6.5 and 8.6 \$/GJ. These costs can compete with those obtained by other processes (natural gas reforming, resid partial oxidation, coal gasification, nuclear fission, solar electrolysis, etc) DOE

**N79-29667#** Istituto Superiore di Sanita, Rome (Italy) Lab delle Radiazioni

**PROBLEMS AND PROSPECTIVES ON SOLAR ENERGY UTILIZATION [PROBLEMI E PROSPETTIVE NELL'UTILIZZAZIONE DELL'ENERGIA SOLARE]**

G Campos Venuti, S Frullani, E Tabet, and P Vecchia 1 Feb 1978 23 p refs In ITALIAN, ENGLISH summary  
(ISS-P-78/1) Avail NTIS HC A02/MF A01

Some aspects and problems related to the development of solar technologies are discussed. Special attention is devoted to the development outlook for solar electric conversion techniques, mainly via the photovoltaic effect, which is estimated to have the best potential, especially considering the efficiency increase and cost reduction of these devices foreseen in the near future. The particular problems related to solar energy development in Italy are discussed separately. Author (ESA)

**N79-29668#** Open Univ., Milton (England) Energy Research Group

**ALTERNATIVE ENERGY SOURCES: AN ANALYSIS OF THEIR ROLE IN ENERGY POLICY**

P F Chapman 1978 64 p refs  
Avail NTIS HC A04/MF A01

Combined heat and power, substitute natural gas, solar energy, and wave power are examined then compared with traditional and nuclear energy sources. The study refers to Great Britain's needs and energy policy up to the year 2025. Wave power is shown to be the most attractive potential source. Nuclear power shows poor performance compared to other alternatives. A power demand growth rate leveling off at 1 percent per year is assumed. Electric car development is considered very probable and beneficial to rational use of energy. Author (ESA)

**N79-29669#** Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes (France)

**SOLAR CELLS MADE FROM POLYCRYSTALLINE SILICON European Concerted Action Photopiles Solaires Final Report [REALISATION DE CELLULES SOLAIRES A PARTIR DE SILICIUM POLYCRISTALLIN]**

E Fabre Oct 1978 34 p refs In FRENCH, ENGLISH summary  
(Contract DGRST-76-7-1495)  
(LEP-78/519-679-D) Avail NTIS HC A03/MF A01

Three structures were investigated relative to their use as the collecting junction of solar cells made from polycrystalline silicon. These are n + / p homojunction, MIS barrier, heterojunction involving indium oxide. The n + / p homojunction, as obtained using a modified diffusion process, yielded the best result per cent under AM1 conditions. The paramount influence of the silicon-carbon interface on the conversion efficiency was revealed. An increase of the minority carrier diffusion length was observed as a function of the incident light flux. Author (ESA)

**N79-29670#** KVB, Inc., Minneapolis, Minn.  
**FIELD TESTS OF INDUSTRIAL STOKER COAL-FIRED BOILERS FOR EMISSIONS CONTROL AND EFFICIENCY**

**IMPROVEMENT: SITE A (DATA SUPPLEMENT) Supplement Report, Jun. - Dec 1977**

J E Gabrielson, P L Langsjoen, and T C Kosvic Dec 1978 279 p refs  
(Contract EF-77-C-01-2609)  
(PB-293731/6, EPA-600/7-78-136B) Avail NTIS  
HC A13/MF A01, CSCL 13A

A compilation of test data is presented. Panel board data for each test, detailed particulate, O<sub>2</sub>, CO<sub>2</sub>, CO, NO, SO<sub>2</sub>, and SO<sub>3</sub> data, particle size distribution data, modified spoke spot data, and data on chemical analysis of the coal and coal size consistency are included. GRA

**N79-29671#** Old West Regional Commission, Billings, Mont.  
**ENERGY RESEARCH INFORMATION SYSTEM, VOLUME 3, NO. 1 (PROJ NOS 00001081 THROUGH 00001224)**

Catherine A Boyd, comp and Laura Schillinger, comp Aug 1978 98 p Sponsored in part by DOE and Geol Survey  
(PB-294342/1, OWRC/ERIS-7808) Avail NTIS  
HC A02/MF A01 CSCL 10B

An inventory of the energy related programs and research activities from 1974 to the present in the states of Montana, Nebraska, North Dakota, South Dakota, and Wyoming is provided. Coal, petroleum, oil shales, fission fuels, synthetic fuels, hydroenergy, renewable energy resources, energy policy, reclamation, socioeconomic impacts, environmental impacts and land use are topics included. GRA

**N79-29672#** Old West Regional Commission, Billings, Mont.  
**ENERGY RESEARCH INFORMATION SYSTEM, VOLUME 3, NO. 2 (PROJECT NOS 00001225 THROUGH 00001362) Report, Aug - Dec, 1978**

Catherine A Boyd, comp and Janet Jelinek, comp Dec 1978 117 p Sponsored in part by DOE and Geol Survey  
(PB-294951/9, OWRC/ERIS-7812) Avail NTIS  
HC A06/MF A01 CSCL 10B

An inventory of the energy-related programs and research activities from 1974 to the present in the states of Montana, Nebraska, North Dakota, South Dakota, and Wyoming, is presented. Areas of research covered include coal, petroleum, oil shales, fission fuels, synthetic fuels, hydroenergy, renewable energy resources, energy policy, reclamation, socioeconomic impacts, environmental impacts and land use. Each project description lists title, investigator, research institution, sponsor, funding, time frame, location, a description abstract of the research and title reports. Projects are publications generated by the research. All projects are indexed by location, personal names, organizations and subject keywords. GRA

**N79-29673#** Old West Regional Commission, Billings, Mont.  
**ENERGY RESEARCH INFORMATION SYSTEM, VOLUME 3, NO 3 PROJECTS REPORT CUMULATIVE INDEXES Report, Apr. 1977 - Dec. 1978**

Catherine A Boyd, comp and Janet Jelinek, comp Jan 1979 76 p Sponsored in part by DOE and Geol Survey  
(PB-294952/7, OWRC/ERIS-7901) Avail NTIS  
HC A05/MF A01 CSCL 10B

The cumulative indexes include a state-location index, a personal name index, and organization index and a subject keyword index incorporating the indexes from ERIS Volume 3, No 1 and 2 and 3, comprises a set of 1362 research project references for the States of the Old West region. GRA

**N79-29674#** Executive Office of the President, Washington, D C  
Assistant to the President for Intergovernmental Affairs  
**RURAL DEVELOPMENT INITIATIVES ENERGY FOR RURAL AMERICA**

May 1979 24 p  
(PB-295234/9) Avail NTIS HC A02/MF A01 CSCL 10A

The initiatives undertaken to provide energy for rural America are described. These initiatives include small-scale hydroelectric power, the production of natural gas from coal and shale, the production of gasohol from renewable agricultural products, and the use of wood as a source of energy. GRA

**N79-29683# Arizona State Univ Tempe Coll of Mines  
POLLUTANT CONTROL THROUGH STAGED COMBUSTION  
OF PULVERIZED COAL**

J O L Wendt J W Lee and J W Glass Jun 1978 26 p  
refs

(Contract EX-76-C-01-1817)

(FE-1817-5) Avail NTIS HC A03/MF A01

A 2Kg/h pulverized-fuel, plane-flame combustor was used to determine time-resolved NO profiles under fuel rich and staged combustion conditions. Seven solid fuels, including two coal chars, were investigated. Results show that at all fuel rich conditions NO is formed rapidly and then is slowly destroyed. The peak NO value and the rate of destruction are strong functions of coal composition and stoichiometry. Under staged combustion conditions, NO may increase or decrease at the staging point depending on the fuel and on the quantity of NO formed in the first stage. Use of artificial oxidants confirmed that the NO formed in the first and second stages consisted of fuel NO. Heterogeneous formation and reduction of NO during char combustion was modeled by a two reaction scheme. Heterogeneous reduction was less than first order in NO and had an activation energy of 47 kcal/mole. The roles of devolatilization and homogeneous reactions are discussed in the light of the data presented. DOE

**N79-29709# North Carolina Univ at Chapel Hill Dept of  
Environmental Sciences and Engineering**

**ASSESSMENT OF COAL CONVERSION WASTE-WATERS.  
CHARACTERIZATION AND PRELIMINARY BIOTREAT-  
ABILITY Technical Report, Nov 1976 - May 1978**

P C Singer F K Pfaender, J Chinchilli, A F Maciorowski,  
and J C Lamb, III Sep 1978 116 p refs

(Grant EPA-R-804917)

(PB-294338/9, EPA-600/7-78-181) Avail NTIS  
HC A06/MF A01 CSDL 13B

Characteristics of coal conversion wastewaters were obtained from the literature and from information gathered during visits to facilities for coal conversion process development. About 60-80% of total organic carbon is phenolic. Remaining organic material includes, nitrogen-containing aromatics, oxygen and sulfur-containing heterocyclics, polynuclear aromatic hydrocarbons, and simple aliphatic acids. A synthetic wastewater was formulated which includes 28 organic compounds, inorganic nutrients, and pH buffering additives. For each class of compounds in real wastewaters one or more representatives are in the synthetic wastewater at the appropriate mean concentrations. Experiments are underway using the synthetic wastewater at quarter strength in four 25-liter biological treatment units. These units are to test biodegradability as a function of retention time and produce acclimated microorganisms for use in respirometric studies. GRA

**N79-29716 Stanford Univ, Calif  
EVALUATION OF INTERMEDIATE-PERIOD SEISMIC  
WAVES AS A GEOTHERMAL EXPLORATION TOOL  
Ph D Thesis**

Robert George Daniel 1979 143 p

Avail Univ Microfilms Order No 7917220

The usefulness of 1 to 30 sec seismic waves in locating sources of geothermal energy in the crust and upper mantle was investigated using a portable, rugged field recording system to measure teleseismic shear wave travel time delays and surface wave phase velocities on the site of a powerful crustal heat source. Yellowstone caldera, Wyoming. Seismic data obtained and previous U S G S experiments in the Yellowstone area were combined to yield a model for seismic velocities and Poisson's ratio beneath the caldera. The low shear velocities and high Poisson's ratio below approximately 4.5 km depth are strong evidence for the presence of a partial melt zone penetrating the entire crustal thickness. Volume and anomalous heat content of this body are estimated at  $1.5 \times 10^{10}$  to  $10^{11}$  power cu km and  $4.5 \times 10^{10}$  to  $2.2 \times 10^{11}$  power cal. Dissert Abstr

**N79-29743# Atomics International Canoga Park Calif  
DETERMINISTIC INSULATION MODEL PROGRAM DE-  
SCRIPTION AND USER'S GUIDE**

E P French Jul 1978 53 p refs

(Contract EY-76-C-04-0789)

(SAND-78-7044) Avail NTIS HC A04/MF A01

A simple mathematical model is described for estimating the monthly average insolation experienced by a fixed or tracking collector. It is designed to fulfill the need for a rapid, economical method of assessing the availability of solar radiation as a basis for site selection and system performance estimation. It attempts to make maximum use of predictable factors, introducing random factors associated with local weather in the simplest way possible. The method lends itself to a formulation in terms of simple mathematical expressions and is suitable for use by hand calculators and small computers. DOE

**N79-29783# Dames and Moore, Los Angeles, Calif  
THE MISSISSIPPI, ALABAMA, FLORIDA, OUTER CONTI-  
NENTAL SHELF BASELINE ENVIRONMENTAL SURVEY,  
MAFLA, 1977/1978 VOLUME 1-B EXECUTIVE SUM-  
MARY REPORT Final Report**

26 Jan 1979 30 p

(Contract DI-AA550-CT7-34)

(PB-294228/2, Rept-08699-008-88-Vol-1-B)

BLM/YM/ES-79/02-Vol-1-B) Avail NTIS HC A03/MF A01  
CSDL 13B

Potential impacts on the outer continental shelf (OCS) environment from oil and gas development are discussed. Methodology, geology, physical oceanography, chemistry, and biology are among the factors considered. A brief summary and lists of recommended monitoring parameters and major deficiencies in the data base are also included. GRA

**N79-29798 Michigan State Univ, East Lansing  
A GENERAL PURPOSE ELECTROANALYTICAL SYSTEM  
BASED ON A MICROCOMPUTER CONTROLLED COULO-  
STATIC GENERATOR Ph D Thesis**

Spyros Emmanouel Hourdakis 1978 198 p

Avail Univ Microfilms Order No 7917713

A microcomputer controlled and operated electrochemical analysis system was developed and in its polarographic mode it was shown to be more sensitive than polarography in the determination of cadmium. A charge generator was designed which uses the charge injection technique to add charge pulses into the electrochemical cell. The characteristics of the charge generator were studied and its operation is discussed. The function of the charge generator is the injection of charges into the cell and the function of the voltage measurement system. The advantages of the multimicrocomputer system over the single microcomputer, for real time control of the instrument, are the speed, the modularity and the convenience of the programming of the system. The electrochemical system was applied in the polarographic determination of cadmium. Dissert Abstr

**N79-30036# Argonne National Lab, Ill  
POTASSIUM SEED ACTIVITIES IN OPEN-CYCLE MHD  
SYSTEM. PREDICTIONS USING A MULTIPHASE MULTI-  
COMPONENT SOLUTION MODEL**

C C Hsu and C E Johnson 1978 33 p refs. Presented at the 10th Mater Res Symp on Characterization of High Temp Vapors and Gases, Gaithersburg Md 18-22 Sep 1978

(Contract W-31-109-eng-38)

(CONF-780941-6) Avail NTIS HC A03/MF A01

A multiphase multicomponent solution model was developed by modifying the computer program for calculation of complex chemical equilibrium compositions to include a subroutine that calculates solution formation from the condensed phase species. This model was used to predict the potassium activity in the  $K_2O + SiO_2$ ,  $K_2O + SiO_2 + Al_2O_3$ ,  $K_2O + SiO_2 + MgO$  and  $K_2O + SiO_2 + CaO$  systems over the temperature range of 2300 to 1200 K in which condensed phase components (i.e.,  $K_2SiO_3$ ,  $K_2Si_2O_5$ ) were assumed to form an ideal solution. Calculations showed that the addition of  $Al_2O_3$ ,  $CaO$  or  $MgO$  to the  $K_2O$ - $SiO_2$  binary system resulted in an increase in potassium activity in the gas phase, especially for  $CaO$ . Such information improves predictive capability and may be used in the selection of materials and in establishing optimum conditions for operation of the combustor-generator high temperature air heater components of an open cycle MHD system. DOE

**N79-30088#** Department of Energy, Oak Ridge, Tenn Technical Information Center

**ENERGY INFORMATION DATA BASE SERIAL TITLES, SUPPLEMENT 3**

Dec 1978 80 p refs

(TID-4579-R10-Suppl-3) Avail NTIS HC A05/MF A01

Changes and additions to TID-4579-R10 (the authority list for serial titles used by TIC) are contained in this supplement. The supplement is intended to be used with that publication.

DOE

**N79-30102#** Department of Energy, Washington, D C  
**ENVIRONMENTAL READINESS DOCUMENT. URBAN WASTE ENERGY RECOVERY COMMERCIALIZATION PHASE 3 PLANNING**

Sep 1978 28 p refs

(DOE/ERD-0002) Avail NTIS HC A03/MF A01

Environmental Readiness Documents are prepared periodically to review and evaluate the environmental status of an energy technology during the several phases of development of that technology. Through these documents, an independent and objective assessment of the environmental risks and potential impacts associated with the extensive use of the technology is provided. This document was prepared to assist the DOE Commercialization Task Force on Urban Waste Energy Recovery to evaluate the commercial readiness of this technology with respect to environmental issues. An effort was made to identify potential environmental problems that may be encountered based upon current knowledge, proposed and possible new environmental regulations and the uncertainties inherent in planned environmental research.

G Y

**N79-30105#** Canterbury Univ., Christchurch (New Zealand)  
**ENERGY RECOVERY AND CONSERVATION BY RECYCLING MUNICIPAL SOLID WASTE M S. Thesis**

Barbara Rouse (Lincoln Coll.) and David Lindley. New Zealand Energy Res and Develop Comm. Oct 1978 38 p refs (NZERDC-P7, ISSN-0110-5388) Avail NTIS HC A03/MF A01

The utilization of recycled materials as energy sources for 2% of the industrial energy in New Zealand is presented. Plans for expanding this program into other energy consuming areas is considered.

DOE

**N79-30107#** Market Facts, Inc. Washington D C  
**ELECTRIC HYBRID VEHICLES FOCUS GROUP RESEARCH**

Aug 1978 39 p refs

(Contract EV-78-C-01-6458)

(DOE/TIC-10009) Avail NTIS HC A03/MF A01

The evaluation of barriers and opportunities associated with successful commercialization of electric hybrid vehicles, and the evaluation of appropriate Federal actions for promoting and facilitating commercialization of these vehicles is presented. Whether electric hybrid vehicles represent the appropriate alternative technology for DOE commercialization efforts is emphasized.

DOE

**N79-30262\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
DSN Engineering Section

**COMPARISON OF TWO TOTAL ENERGY SYSTEMS FOR A DIESEL POWER GENERATION PLANT**

V W Chai. In: *The Deep Space Network*. 15 Aug 1979 p 89-93 ref

Avail NTIS HC A06/MF A01 CSCL 10B

The capabilities and limitations, as well as the associated costs for two total energy systems for a diesel power generation plant are compared. Both systems utilize waste heat from engine cooling water and waste heat from exhaust gases. Pressurized water heat recovery system is simple in nature and requires no engine modifications, but operates at lower temperature ranges. On the other hand, a two-phase ebullient system operates the engine at constant temperature, provides higher temperature water or steam to the load, but is more expensive.

M M M

**N79-30393** Committee on Science and Technology (U S House)  
**BIOCONVERSION**

Washington GPO 1978 409 p refs. Hearings before the Subcomm on Advanced Energy Technologies and Energy Conservation Res. Development and Demonstration of the Comm on Sci and Technol. 95th Congr. 2d Sess., 15 Jul and 5 Aug 1978.

(GPO-37-136) Avail Subcomm on Advanced Energy Technologies and Energy Conservation Res., Development and Demonstration.

Testimony and statements on issues and priorities surrounding the development of bioconversion (biomass energy conversion) in the different geographical regions of the United States are presented.

R E S

**N79-30394#** Maryland Univ., College Park  
**COOPERATIVE EXTENSION SERVICE ENERGY RESOURCE NOTES**

Jul 1979 12 p refs

Avail NTIS HC A02/MF A01

The production, potential uses, legislation, availability, and economic feasibility of gasohol in Maryland are addressed.

M M M

**N79-30396#** Chevron Research Co., Richmond, Calif  
**CONVERTING GREEN RIVER SHALE OIL TO TRANSPORTATION FUELS**

R F Sullivan and B E Stangeland. 1978 41 p refs. Presented at the 11th Oil Shale Symp., Golden, Colo., 11 Apr 1978 (Contract EX-76-C-01-2315).

(CONF-780460-3) Avail NTIS HC A03/MF A01

Pilot plant data for three processing schemes were generated: hydrotreating followed by hydrocracking, hydrotreating followed by fluid catalytic cracking, and delayed coking followed by hydrotreating. Yields and product inspections are presented for these three cases.

DOE

**N79-30397#** Rocketdyne, Canoga Park, Calif  
**HYDROGASIFIER DEVELOPMENT FOR THE HYDRANE PROCESS Annual Report, Mar 1977 - Feb 1978**

Jun 1978 273 p refs

(Contract EX-77-C-01-2518)

(FE-2518-17) Avail NTIS HC A12/MF A01

Work performed on a program to develop a single-stage short-residence-time reactor for flash hydrogasification of coal is described. Experiments involve two different hydrogasifier reactor systems. The first is a bench-scale apparatus with coal feed rates of 2 to 4 lb/hr. Results are reported for a subbituminous coal reacted with hydrogen pressures up to 1600 psig, reactor temperatures ranging from 1475 to 1728 F, and residence times ranging from 300 to 3500 msec. Overall carbon conversions were quite comparable with conversion of lignite observed previously. The second reactor has a nominal coal feed rate of 1/4 ton/hr. Results from tests with subbituminous coal compared well with those from the bench-scale reactor. A computerized numerical model was developed for pulverized coal flow and reaction in an entrained-flow reactor. Formulation and computer programming of the reactor model are described and some preliminary results from selected 1/4 ton/hour experiments are discussed.

DOE

**N79-30398#** Oak Ridge National Lab., Tenn  
**COAL LIQUEFACTION ADVANCED RESEARCH DIGEST**

F M OHara, Jr. Feb 1979 51 p refs

(Contract W-7405-eng-26)

(ORNL/FE-2) Avail NTIS HC A04/MF A01

The solvent refined coal-2 (SRC-2) process, the consol synthetic fuel (CSF) process, and the Fischer-Tropsch synthesis are reviewed. The histories of the chemical processes are traced and present states of knowledge are detailed. The SRC-2 process combines dissolution and hydrogenation to produce hydrocarbon fuels. The CSF process splits dissolution and hydrogenation into two distinct steps and employs indirect hydrogenation. The Fischer-Tropsch synthesis catalytically produces hydrocarbons from carbon monoxide and hydrogen.

K L



**N79-30399#** Department of Energy, Washington, D C  
Economic Regulatory Administration

**MOTOR GASOLINE DEREGULATION AND THE GASOLINE  
TILT Final Report**

Jan 1979 390 p refs

(DOE/EIS-0039-Vol-1) Avail NTIS HC A17/MF A01

The environmental impact statement evaluates the environmental impacts, including social and economic impacts, that may result from the exemption of motor gasoline from DOE's mandatory petroleum price and allocation regulations, and the adoption of the gasoline tilt, a proposed regulation that would allow refiners to recover an additional amount of their total increased costs on gasoline. The impacts of the two proposals are considered separately rather than cumulatively. A principal reason for adopting either of these proposals is to eliminate the impediments in current regulations that prevent refiners from recovering, in the prices charged for gasoline, the full amount of costs associated with producing gasoline. Adoption of either proposal may be necessary to encourage increased investments in refining capacity and to prevent shortages of gasoline, particularly unleaded gasoline, after 1980. DOE

**N79-30400#** Department of Energy, Washington, D C Energy  
Information Administration

**NATIONAL COAL MODEL COAL SUPPLY CURVES**

Sep 1978 218 p

(DOE/EIA-0103/2) Avail NTIS HC A10/MF A01

The computerized National Coal Model (NCM) is designed to project future levels of United States coal production, consumption, and prices and to permit the analysis of the impact of coal related public policy issues on such factors. Four major functional components, or modules are integrated coal supply, electric utility coal demand, nonelectric utility coal demand, and coal transportation. The model has a high degree of resolution and includes 30 supply regions, 35 demand regions, 40 possible coal types, and six consuming sectors. The coal supply component of the NCM is described and the detailed coal supply curves which are its primary output are presented. DOE

**N79-30401#** Department of Energy, Washington, D C  
Economic Regulatory Administration

**MOTOR GASOLINE DEREGULATION AND THE GASOLINE  
TILT. VOLUME 2: PUBLIC COMMENTS Final Environmental  
Impact Statement**

Jan 1979 567 p

(DOE/EIS-0039-Vol-2) Avail NTIS HC A24/MF A01

The oral comment statement submitted at the December 19, public hearing are contained as well as all the written comments which DOE received on the draft EIS as of the date of publication. Related to the findings in the final EIS is an Analysis Memorandum 1980 Motor Gasoline Supply and Demand, which was prepared by DOE's EIA. Included are the written comments received from the public on the analysis memorandum. DOE

**N79-30402#** Department of Energy, Washington, D C Energy  
Information Administration

**FACT SHEET. FORECASTED AUTOMOBILE GASOLINE  
CONSUMPTION**

H Walton and F Emerson May 1978 11 p refs

(DOE/EIA-0102/1) Avail NTIS HC A02/MF A01

The impact of the use of alternative assumptions on projected 1985 automobile gasoline consumption is discussed. The level of 1985 automotive gasoline consumption consistent with meeting EPCA standards under the alternative mileage degradation relationships was found to range between 81.7 and 88.5 billion gallons. DOE

**N79-30403#** Department of Energy, Washington, D C Energy  
Information Administration

**PETROLEUM SUPPLY/DEMAND ESTIMATES AND COST  
OF PETROLEUM EXPORTS, 1978-1979**

R Farmer, C Bwyer, S Atkinson, and D Ahl 5 Feb 1979  
29 p

(DOE/EIA-0102/40) Avail NTIS HC A03/MF A01

Total demand for refined products in 1979 is estimated at between 19.2 and 19.7 million barrels daily, compared with

18.7 million barrels per day in 1978. Demand for motor gasoline in 1979 is expected to be between 7.4 and 7.7 million barrels daily, compared with 7.4 million barrels daily in 1978. To meet the 1979 demand projections, domestic crude production of 8.5 to 8.7 million barrels daily is expected to be supplemented, respectively by 7.4 to 6.9 million barrels of imported crude oil daily. Total petroleum imports (including product) to the 50-State area covered by the DOE imports statistics are expected to average 8.7 to 9.3 million barrels daily in 1979. The cost of petroleum imports to the U.S. balance of payments area, including net imports to U.S. territories such as Puerto Rico and Virgin Islands is expected to be \$52 to \$55 billion in 1979, (in current dollars). These estimates include over \$2 billion for Strategic Petroleum Reserve crude oil purchases. DOE

**N79-30405#** Department of Energy, Washington, D C Energy  
Information Administration

**PETROLEUM SUPPLY VULNERABILITY, 1985**

G D Butler and W C Kilgore 8 Jan 1979 39 p refs

(DOE/EIA-0102/44) Avail NTIS HC A03/MF A01

Potential U.S. petroleum supply shortfalls are assessed for the year 1985. The potential 1985 shortfalls vary significantly over various scenarios, ranging from 2.6 to 8.5 million barrels per day. The shortfalls increase as the economic growth rate increases. The imposition of an OPEC production capacity constraint diminishes the level of the shortfalls due to the reduced demand growth brought about by increasing world oil prices. Projected OPEC production at constant oil prices is less than the assumed OPEC production capacity. DOE

**N79-30406#** Department of Energy, Washington, D C Energy  
Information Administration

**OIL AND GAS SUPPLY CURVES FOR THE ADMINIS-  
TRATOR'S ANNUAL REPORT**

14 Sep 1978 114 p ref

(DOE/EIA-0103/4, TM/ES/78-17)

Avail NTIS

HC A06/MF A01

Regional supply curves are presented for crude oil, natural gas, and natural gas liquids for the years of 1985 and 1990. These curves are generated by DOE's Oil and Gas Model and are part of the database for PIES, a static equilibrium model. The PIES system integrates supply and demand and other factors in energy markets for each region and for several categories of product. The supply projections are based on economic and engineering factors which effect oil and gas supply decisions. The DOE model produces a supply forecast for crude oil, associated-dissolved natural gas, and associated natural gas liquids production which consists of a fifteen year production series based on an assumed new oil price trajectory. The DOE gas model likewise produces a fifteen year production forecast of non-associated natural gas and natural gas liquids based on an assumed trajectory for new natural gas prices. The oil and gas modeling system then combines several oil and gas cases to produce a supply curve for a given year. DOE

**N79-30407#** Department of Energy, Washington, D C  
STRATEGIC PETROLEUM RESERVE: EXPANSION OF  
RESERVE. FINAL SUPPLEMENT TO FINAL ENVIRONMEN-  
TAL IMPACT STATEMENT Final Report

Jan 1979 397 p refs

(DOE/EIS-0034) Avail NTIS HC A17/MF A01

The environmental impacts of storing one hundred fifty million barrels (MMB) of oil by 1978 and five hundred MMB by 1982 are addressed. The most sensitive parameters appear to be water quality and geology. The adverse impacts that could result from the expanded program include the degradation of surface water quality from construction runoff, increased dredging, and more frequent oil spills. In addition, brine disposal associated with solution mining salt cavities will increase the salinity of the receiving waters, whether underground saline aquifers or small portions of the Gulf of Mexico. Changes in water quality will have a short-term impact on aquatic organisms in local areas. Use of large quantities of ground water for developing salt cavities could cause some surface subsidence over water storage areas, slow salt water encroachment, and movement of near-surface geologic faults. DOE

**N79-30408#** Institute of Gas Technology, Chicago, Ill  
**BEHAVIOR OF GAS DISTRIBUTION EQUIPMENT IN HYDROGEN SERVICE**

Jon B Pangborn, Dale G Johnson and Walter J Jasionowski  
 1979 16 p refs Presented at 14th World Gas Conf., Toronto,  
 27 May - 1 Jun 1979

(Contract EY-76-C-02-2907)

(CONF-790512-2) Avail NTIS HC A02/MF A01

Prospects for hydrogen delivery in conventional gas distribution systems are addressed. Three model distribution systems were constructed and operated using components loaned or donated by manufacturers and gas utility companies. Specific components for any evident effects of hydrogen exposure are examined. It was experimentally observed that energy delivery as hydrogen could be about 80% that of natural gas under the same operating conditions using a distribution model. Volumetric leakage ratios (hydrogen-to-natural gas) of 2.6:1 to 4.6:1 were measured for various different components in the model systems. DOE

**N79-30410#** Department of Energy, Washington, D C Office of Building and Community Systems

**PROCEEDINGS OF A SYMPOSIUM ON THE UTILIZATION OF METHANE GENERATED IN LANDFILLS**

1978 34 p refs Symp held at Laurel, Md., 9-10 Mar 1978  
 (Grant EM-78-G-01-4206)

(CONF-780340) Avail NTIS HC A03/MF A01

Past and present experiences in the production of landfill methane in California, New York, and Colorado are summarized. Technical and institutional factors related to the use of landfill methane are identified. The problems identified in implementation included technology transfer, decision-making on the part of local government as to its appropriateness, optimization of recovery, little correlation between laboratory tests and field experiences, design of gas gathering systems, overall landfill design and siting, regulatory restrictions, financing mechanisms, information transfer, and uncertainties on gas ownership and legal liabilities. DOE

**N79-30412#** Salzgitter AG (West Germany)

**METHANE AND METHANOL AS ALTERNATIVE ENERGY SOURCES: A COMPARATIVE PROFITABILITY STUDY** Final Report

Heinrich Deipenau Bonn Bundesmin fuer Forsch u Technol  
 Dec 1978 357 p refs In GERMAN, ENGLISH summary

(Contract BMFT-ETS-3057-A)

(BMFT-FB-77-84) Avail NTIS HC A16/MF A01, ZLDI, Munich DM 74,35

Elaborations of the economic and technical ways and means for the supply of LNG and methanol to industrial centers, using natural gas from the Iranian area as raw material, were compared. The classification of given possibilities for the preparation, transportation and storage of potential sources of energy is discussed. Cost estimates of transportation, a comparative examination of economic and technical aspects, and a description of the use of LNG and methanol in Germany (motor cars, power plants, gas supply) are presented. It is concluded that energy costs for LNG in Wilhelmshaven are lower than those for methanol, and that large quantities of LNG and methanol from the Persian Gulf can be sold in the various sectors of the German energy market on the condition that crude gas prices on the Persian Gulf do not exceed 3-DM/Gcal. Author (ESA)

**N79-30413#** National Technical Information Service, Springfield, Va

**HYDROGEN STORAGE, PART 1 STORAGE AS A GAS OR LIQUID A BIBLIOGRAPHY WITH ABSTRACTS** Progress Report, 1974 - May 1979

Diane M Cavagnaro Jun 1979 135 p

(NTIS/PS-79/0581) Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

This bibliography references aspects of storing hydrogen fuels as a liquid or gas. Topics covered include fuel storage, energy storage, and the construction of storage tanks, Batteries, fuel cells, and solar cells, if related to hydrogen storage, are also mentioned. GRA

**N79-30415#** Boeing Engineering and Construction, Seattle Wash

**MOD-2 FAILURE MODE AND EFFECTS ANALYSIS**

Robert Lynette and Robert Poore Jul 1979 302 p Sponsored by NASA

(Contract DEN3-2 DE-AI01-79ET20485)

(NASA-CR-159632) Avail NTIS HC A14/MF A01 CSCL 13L

The results of a failure mode and effects analysis of the Mod-2 wind turbine are presented. Author

**N79-30499#** B & K Engineering, Inc Towson, Md

**DEVELOPMENT OF CRYOGENIC THERMAL CONTROL HEAT PIPES** Final Report

Aug 1978 40 p refs

(Contract NAS2-9613)

(NASA-CR-152302, BK042-1012)

Avail NTIS

HC A03/MF A01 CSCL 20D

The development of thermal control heat pipes that are applicable to the low temperature to cryogenic range was investigated. A previous effort demonstrated that stainless steel axially grooved tubing which met performance requirements could be fabricated. Three heat pipe designs utilizing stainless steel axially grooved tubing were fabricated and tested. One is a liquid trap diode heat pipe which conforms to the configuration and performance requirements of the Heat Pipe Experiment Package (HEPP). The HEPP is scheduled for flight aboard the Long Duration Flight Exposure Facility (LDEF). Another is a thermal switch heat pipe which is designed to permit energy transfer at the cooler of the two identical legs. The third thermal component is a hybrid variable conductance heat pipe (VCHP). The design incorporates both a conventional VCHP system and a liquid trap diode. The design, fabrication and thermal testing of these heat pipes is described. The demonstrated heat pipe behavior including start-up, forward mode transport, recovery after evaporator dry-out, diode performance and variable conductance control are discussed. F O S

**N79-30522#** Argonne National Lab., Ill

**FLOW-INDUCED VIBRATION IN SHELL-AND-TUBE HEAT EXCHANGERS FOR OCEAN THERMAL ENERGY CONVERSION (OTEC)**

J J Lorenz and D Yung Aug 1978 49 p refs

(Contract EY-76-C-02-0016)

(ANL-OTEC-78-3) Avail NTIS HC A03/MF A01

The problem of crossflow-induced vibration in shell-and-tube heat exchangers for OTEC was considered. Models of the dominant excitation mechanisms are discussed: vortex shedding, turbulent buffeting, fluid-elastic instability, and acoustic excitation. Criteria are presented for assessing vibration and equations are derived for predicting the maximum allowable span length as a function of crossflow velocity and other system variables. Also, regions of acoustic resonance and noise are defined. Among the system variables studied are tube diameter, tube material, tube-field layout, and pitch to diameter ratio. All models are presented in a simple form that can readily be applied to the mechanical design of OTEC heat exchangers. DOE

**N79-30599#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

**REMOTE SENSORS APPLIED TO THE PROSPECTING OF THERMOMINERAL WATERS IN THE MUNICIPALITY OF CALDAS NOVAS-GOIAS [SENSORES REMOTOS APLICADOS A PROSPECCAO DE AGUAS TERMOMINERAIS NO MUNICIPIO DE CALDAS NOVAS-GOIAS]**

Nelson de Jesus Parada Principal Investigator, Paulo Veneziani, and Celso Eustaquio dos Sanjos Jan 1979 16 p refs In PORTUGUESE Sponsored by NASA ERTS

(E79-10238, NASA-CR-158802 INPE-1413-RPE/001) Avail NTIS HC A02/MF A01 CSCL 08H

**N79-30609#** California Univ., Berkeley Lawrence Berkeley Lab

# **GEOHERMAL EXPLORATION ASSESSMENT AND INTERPRETATION, KLAMATH BASIN, OREGON - SWAN LAKE AND KLAMATH HILLS AREA**

M Stark N Goldstein H Wollenberg B Strisower, H Hege and M Wilt May 1979 83 p refs  
(Contract W-7405-eng-48)

(LBL-8186) Avail NTIS HC A05/MF A01

A synthesis and preliminary interpretation of predominantly geophysical information relating to the Klamath Basin geothermal resource is presented. The Swan Lake Valley area northeast of Klamath Falls, and the Klamath Hills area south of Klamath Falls, are discussed in detail. Available geophysical data, including gravity, magnetic electrical resistivity, microearthquake, moving dipole resistivity, audio magnetotelluric (AMT) and magnetotelluric (MT) data sets, are examined and reinterpreted for these areas. One and two dimensional modeling techniques are applied and general agreement among overlapping data sets is achieved. The MT method appears well suited to this type of exploration, although interpretation is difficult in the complex geology. Moving dipole and AMT are useful in reconnaissance, while gravity and magnetics help in defining structure. Author

# **N79-30686# Department of Energy Washington D C Oil, Gas Shale and In Situ Technology Div OFFICE OF NAVAL PETROLEUM AND OIL SHALE RESERVE REPORT OF OPERATIONS, 1 OCTOBER 1978 Annual Report**

Dec 1978 50 p

(DOE/RA-0011) Avail NTIS HC A03/MF A01

Total production for FY 1978 from Elk Hills averaged 119,138 barrels of oil per day (BOPD). The Government's share of this production was approximately 100,000 BOPD. During this period, the Government's share of production was sold at two crude oil sales. At year end, two rigs were active in the development of the Shallow Oil zone, six in the Stevens Zone and one in the Carneros Zone. Earlier in the year, two additional rigs were utilized for drilling deep exploratory test wells. No new productive horizons were discovered. During FY 1978 production at Teapot Dome averaged 1,957 BOPD. All sales during FY 1978 were to one purchaser. Activities included continuation of a three-year surface hydrology study, completion of a seven-well corehole program initiated in FY 1977, and the implementation of another three-well corehole program. DOE

# **N79-30687# Oak Ridge National Lab Tenn TECHNICAL ASPECTS OF THE RESOURCE CONSERVATION AND RECOVERY ACT UPON COAL COMBUSTION AND CONVERSION SYSTEMS**

D W Weeter and M P Bahor Feb 1979 76 p refs  
(Contract W-7405-eng-26)

(ORNL/OEPA-10) Avail NTIS HC A05/MF A01

An extensive literature review was conducted in order to evaluate the hazardous potential of the various solids, literature based leachate data were compared to inorganic drinking water standards. All processes studied even under leaching conditions have a hazardous potential. Two conventional steam generation facilities, which have electrostatic precipitators, but do not have sulfur removal, were used as case studies. In each case, RCRA should induce minimal technical and cost impact. The Federal Water Pollution Control Act and the Federal Clean Air Act may have potentially more future impact on these two plants than does RCRA. It is not certain that this conclusion holds for all conventional steam plants or that it holds for other processes. DOE

# **N79-30688# Department of Energy Washington D C Energy Information Administration BITUMINOUS COAL AND LIGNITE DISTRIBUTION, JANUARY - SEPTEMBER 1978**

8 Jan 1979 77 p

(DOE/EIA-0125/3-78) Avail NTIS HC A05/MF A01

During January-September 1978 production of bituminous coal and lignite in the United States totaled 456 million tons. 448 million tons were shipped for consumption while 8 million tons were stockpiled. Of the total coal distributed in the first nine months of 1978 (Table 1) 422.6 million tons (94 percent)

were delivered to consumers in the United States and 25.7 million tons (6 percent) were exported (9.1 million tons to Canada and 16.6 million tons to Mexico and destinations overseas). A summary of coal shipments by district of origin are summarized. Shipments by geographic division destinations are shown in tables. DOE

# **N79-30689# Oak Ridge National Lab Tenn Analytical Chemistry Div**

## **POLAR CONSTITUENTS OF A SHALE OIL COMPARATIVE COMPOSITION WITH OTHER FOSSIL-DERIVED LIQUIDS**

I B Rubin N A Goeckner (University of Western Ill Macomb) and B R Clark 1979 22 p refs Presented at the Oil Shale Symp., Denver 26 Mar 1979

(Contract W-7405-eng-26)

(CONF-790334-2) Avail NTIS HC A02/MF A01

Similarities and differences in the polar portions of a variety of types of fossil fuel oils including oil from shale from several coal liquefaction processes and from a mixture of natural petroleum crudes are described. Samples were fractionated by acid/base distribution as well as by gel partition chromatography which was then followed by acid/base distribution and adsorption chromatography. One subfraction of particular interest was that obtained from the hydrophilic fraction after gel partition chromatography extracted into a neutral subfraction and then eluted from an alumina column by methanol. This subfraction was not gas chromatographable and was partially characterized by elemental analysis, NMR spectroscopy and infrared spectrophotometry. DOE

# **N79-30691# Department of Energy, Washington D C Energy Information Administration**

## **ANALYSIS OF THE PRODUCTIVITY OF DOMESTIC PETROLEUM EXPLORATION ACTIVITIES**

Jul 1978 61 p

(DOE/EIA-0102/7) Avail NTIS HC A04/MF A01

The recent decline in the productivity of domestic petroleum exploration activities is examined. Data are presented on the recent changes in the productivity of domestic exploration activities and an analysis is provided of a number of underlying economic relationships that are likely influencing the trends in exploration activity. There is suggested a research agenda whose purpose would be to discern the transitory effects that the sudden increases in petroleum prices have had on exploration activities. It is concluded that a significant change in the price of crude oil and/or natural gas could influence the productivity of domestic exploratory drilling. Exploration productivity would be a function not only of the declining quality of drilling prospects, but also of the current (and expected future) price levels. DOE

# **N79-30701# General Accounting Office Washington D C Energy and Minerals Div**

## **UNIQUE HELIUM RESOURCES ARE WASTING A NEW CONSERVATION POLICY IS NEEDED**

7 Mar 1979 116 p

(PB-293751/4, EMD-78-98) Avail NTIS HC A06/MF A01 CSCL 05C

The loss of helium through the use of natural gas, its most economical source, is considered. Available alternatives to conserve helium are discussed. Continuing investment in helium dependent, energy related technologies is predicted to sharply increase demand after the year 2000. The present helium program is shown to be inadequate and in need of congressional legislation to establish Federal responsibility for conserving helium for national needs. GRA

# **N79-30710 California Univ Berkeley ENERGY AND MATERIALS IN THREE SECTORS OF THE ECONOMY: A DYNAMIC MODEL WITH TECHNOLOGICAL CHANGE AS AN ENDOGENOUS VARIABLE Ph.D Thesis**

Alfred Linden Levinson 1978 168 p

Avail Univ Microfilms Order No 7914673

One of the major difficulties encountered when modelling the demand for energy and resources is the lack of an adequate method for introducing technological change into the model. Embodied technological change and its effect on the

technical coefficients of input-output models is examined. The recursive programming method is used to dynamically model embodied technological change in three industries, steel, aluminum, and can manufacturing. The method is composed of two phases, the static and the recursive or dynamic. The static or short run phase uses a linear program to optimize production by the various technologies. The dynamic phase consists of an econometric submodel where the level of investment in the technologies, the marginal cost of the technologies, the supply of some of the material inputs, and the demand for the output of the industries are determined. Dissert Abstr

**N79-30712\*** Miami Univ., Coral Gables, Fla. Dept of Mechanical Engineering  
**DETERMINATION OF POTENTIAL SOLAR POWER SITES IN THE UNITED STATES BASED UPON SATELLITE CLOUD OBSERVATIONS** Final Report, 5 Jun. 1975 - 4 Sep 1977  
 H W Hiser, H V Senn, S T Bukkapatnam, and K Akyuzlu  
 Dec 1977 47 p refs  
 (Contract NAS5-22417)  
 (NASA-CR-159944) Avail NTIS HC A03/MF A01 CSCL 10B

The use of cloud images in the visual spectrum from the SMS/GOES geostationary satellites to determine the hourly distribution of sunshine on a mesoscale in the continental United States excluding Alaska is presented. Cloud coverage and density as a function of time of day and season are evaluated through the use of digital data processing techniques. Low density cirrus clouds are less detrimental to solar energy collection than other types, and clouds in the morning and evening are less detrimental than those during midday hours of maximum insolation. Seasonal geographic distributions of cloud cover/sunshine are converted to langley's of solar radiation received at the earth's surface through relationships developed from long term measurements at six widely distributed stations. A W H

**N79-30713\*** Hittman Associates, Inc., Columbia, Md  
**COMPREHENSIVE COMMUNITY ENERGY PLANNING. VOLUME 2. APPENDICES**  
 Nov 1978 229 p refs 2 Vol  
 (Contract EC-77-C-10-0023)  
 (HCP/M0023-02-Vol-2) Avail NTIS HC A11/MF A01

Energy saving strategies and components for energy conservation in cities and residential areas are presented. Estimates for alternative energy saving measures are discussed in areas of land use, mass transit, and building modifications. Energy conservation plans in these areas, such as tax credits and loans, are discussed and estimation methods are described. A W H

**N79-30716\*** Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div  
**INDOOR TEST AND LONG-TERM WEATHERING EFFECTS ON THE THERMAL PERFORMANCE OF THE SOLAR ENERGY SYSTEM (LIQUID) SOLAR COLLECTOR**  
 May 1979 41 p refs Prepared for DOE  
 (Contract NAS8-32036)  
 (NASA-CR-150794, WYLE-TR-531-23) Avail NTIS HC A03/MF A01 CSCL 10A

The procedures used and the results obtained during the evaluation test program on a liquid solar collector are presented. The narrow flat plate collector with reflective concentrating mirrors uses water as the working fluid. The double-covered collector weighs 137 pounds and has overall dimensions of about 35' by 77' by 6.75'. The test program was conducted to obtain the following information: thermal performance data under simulated conditions, structural behavior under static load, and the effects of long term exposure to natural weathering. K L

**N79-30718\*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena  
**THERMAL POWER SYSTEMS SMALL POWER SYSTEMS APPLICATIONS PROJECT VOLUME 2: DETAILED REPORT**  
 Annual Technical Report, Fiscal Year 1978  
 A T Marriott 15 Jan 1979 212 p  
 (Contract NAS7-100, JPL Proj 5103-36)

(NASA-CR-162104, JPL-Pub-79-43-Vol-2, DOE/JPL-1060-9)  
 Avail NTIS HC A10/MF A01 CSCL 10B

Small power system technology as applied to power plants up to 10 MW in size was considered. Markets for small power systems were characterized and cost goals were established for the project. Candidate power plant system design concepts were selected for evaluation and preliminary performance and cost assessments were made. Break-even capital costs were determined for leading contenders among the candidate systems. The potential use of small power systems in providing part of the demand for pumping power by the extensive aqueduct system of California, was studied. Criteria and methodologies were developed for the ranking of candidate power plant system design concepts. Experimental power plant concepts of 1 MW rating were studied to define a power plant configuration for subsequent detail design construction, testing and evaluation. Site selection criteria and ground rules were developed. K L

**N79-30719\*** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**WIND TURBINES FOR ELECTRIC UTILITIES. DEVELOPMENT STATUS AND ECONOMICS**  
 J R Ramler and R M Donovan 1979 21 p refs Presented at Terrest Energy Systems Conf., Orlando, Fla., 4-6 Jun 1979, sponsored by AIAA  
 (Contract E(49-26)-1028)  
 (NASA-TM-79170, E-035, DOE/NASA/1028-79/23) Avail NTIS HC A02/MF A01 CSCL 10B

The technology and economics of the large, horizontal-axis wind turbines currently in the Federal Wind Energy Program are presented. Wind turbine technology advancements made in the last several years are discussed. It is shown that, based on current projections of the costs of these machines when produced in quantity, they should be attractive for utility application. The cost of electricity (COE) produced at the busbar is shown to be a strong function of the mean wind speed at the installation site. The break-even COE as a fuel saver is discussed and the COE range that would be generally attractive to utilities is indicated. Author

**N79-30720\*** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**PERFORMANCE CHARACTERISTICS OF A SLAGGING GASIFIER FOR MHD COMBUSTOR SYSTEMS** Final Report  
 Kenneth O Smith Jun 1979 49 p refs Sponsored in part by DOE  
 (Contract EF-77-A-01-2674)  
 (NASA-TM-79195, E-072, DOE/NASA/2674-79/6) Avail NTIS HC A03/MF A01 CSCL 10A

The performance of a two stage, coal combustor concept for magnetohydrodynamic (MHD) systems was investigated analytically. The two stage MHD combustor is comprised of an entrained flow, slagging gasifier as the first stage, and a gas phase reactor as the second stage. The first stage was modeled by assuming instantaneous coal devolatilization, and volatiles combustion and char gasification by CO<sub>2</sub> and H<sub>2</sub>O in plug flow. The second stage combustor was modeled assuming adiabatic instantaneous gas phase reactions. Of primary interest was the dependence of char gasification efficiency on first stage particle residence time. The influence of first stage stoichiometry, heat loss, coal moisture, coal size distribution, and degree of coal devolatilization on gasifier performance and second stage exhaust temperature was determined. Performance predictions indicate that particle residence times on the order of 500 msec would be required to achieve gasification efficiencies in the range of 90 to 95 percent. The use of a finer coal size distribution significantly reduces the required gasifier residence time for acceptable levels of fuel use efficiency. Residence time requirements are also decreased by increased levels of coal devolatilization. Combustor design efforts should maximize devolatilization by minimizing mixing times associated with coal injection. K L

**N79-30721\*** Clarksville Community School Corp., Ind  
**SOLAR ENERGY RETROFIT FOR CLARKSVILLE MIDDLE SCHOOL, CLARKSVILLE, INDIANA**  
 Aug 1979 126 p Sponsored in part by NASA

(Contract EG-77-A-01-4076)  
(NASA-CR-161272) Avail NTIS HC A07/MF A01 C5CL  
10A

The solar energy retrofit heating system installed to provide heating for two gymnasiums at the Clarksville Middle School located in Clarksville, Indiana is described in detail. The system type is hot water using existing chilled water piping and chilled water coils in an air handler system. Flat plate, single-glazed selectively coated solar collectors were installed on the roof of each gymnasium. Total collector area covers 6,520 square feet. The liquid is stored in a 10,000 gallon steel tank installed below grade. Author

**N79-30722#** Hittman Associates, Inc., Columbia, Md  
**COMPREHENSIVE COMMUNITY ENERGY PLANNING.**  
**VOLUME 1: A WORKBOOK**

Nov 1978 147 p refs 2 Vol

(Contract EC-77-C-10-0023)

(HCP/M0023-01-Vol-1) Avail NTIS HC A07/MF A01

The project resulted in the development of a methodology and workbook which enables community officials and staff to develop and evaluate energy conservation programs for their community. This methodology is a pioneering effort in the field of community energy planning. As such, many of the procedures generated were not subjected to test and evaluation in actual communities. In an effort to validate the procedures presented, the U S DOE is sponsoring a test and demonstration of this methodology in various selected communities. Based upon the results of these demonstrations, the procedures may require refinement to more accurately reflect actual community needs. G Y

**N79-30723#** Department of Energy, Washington, D C Div  
of Industrial Applications and Commercialization  
**OVEN CURING ENERGY CONSERVATION AND EMISSION**  
**CONTROL IN COIL COATING**

1978 33 p Original contains color illustrations

(TID-28705) Avail NTIS HC A03/MF A01

An energy saving system is presented which recovers heat from the exhaust streams of coil curing ovens. A zone incinerator is retrofitted to the curing ovens to recover and recycle the significant portions of energy lost in the curing process. This reduces the natural gas consumption in the ovens by 74% and the solvent emission by 40 to 60%. The performance and economics of this system are surveyed. A W H

**N79-30724#** Goodyear Atomic Corp., Piketon, Ohio  
**REFRIGERANT-114 RANKINE CYCLE ENERGY RECOVERY**  
**TECHNOLOGY FROM THE GASEOUS DIFFUSION IN-**  
**DUSTRY**

Clair O Langerbrake 8 Sep 1978 39 p refs

(Contract EY-76-C-05-0001)

(GAT-916) Avail NTIS HC A03/MF A01

An unclassified accounting of energy recovery technology developed in the gaseous diffusion (uranium enrichment) industry during the past twenty years is presented. This spin-off knowledge may be of value to those in industry seeking to reduce operating costs while meeting the national objective of conserving energy. Four Rankine cycle energy recovery installations using Refrigerant-114 (R-114) as the working fluid are described, and the conclusions drawn from their operation are given. In all these installations, energy was extracted from waste heat by using R-114 vapor to drive expansion turbines connected to compressor motor shafts. This arrangement resulted either in reducing the electric load on the motor, or, if the motor could be overdriven to act as a generator, in returning electric power to the plant electrical grid. Factors significant in the design of these energy recovery systems, as well as economic and design considerations that may be significant in applications in other industries, are discussed. The following topics are included: the selection of suitable system controls, the superiority of R-114 to steam as the working fluid in some energy recovery systems, the advantages and disadvantages of different turbine types, the uses and limitations of positive contact seals in refrigerant systems, and methods of enhancing energy recovery, such as tracking ambient conditions and using countercurrent flow cooling. F O S

**N79-30725** Committee on Energy and Natural Resources  
(U S Senate)

**SOLAR PHOTOVOLTAIC ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1978**

Washington GPO 1978 116 p refs Hearing on S 3392 and H R 12874 before the Subcomm on Energy Res and Development of the Comm on Energy and Natural Resources, 95th Congr, 2d Sess, 19 Sep 1978

(GPO-36-187, Publ-95-167) Avail Subcomm on Energy Res and Development

Testimony was given and arguments were heard on a bill and an act to provide for an accelerated program of research, development, and demonstration of solar photovoltaic energy technologies leading to early competitive commercial applicability of such technologies to be carried out by the Department of Energy, with the support of NASA, the National Bureau of Standards, the General Services Administration, and other federal Services agencies. M M M

**N79-30726** Committee on Energy and Natural Resources (U S Senate)

**SOLAR POWER SATELLITE RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAM ACT OF 1978**

Washington GPO 1978 270 p refs Hearing on S 2860 and H R 12505 before the Subcomm on Energy and Natural Resources, 95th Congr, 2d Sess, 14 Aug 1978

(GPO-35-994, Publ-95-166) Avail Subcomm on Energy Res and Development

Satellite solar energy conversion transmission to earth to generate electricity for domestic purposes is studied. A space orbiting mirror system designed to provide continuous and slightly concentrated reflected solar energy to selected solar conversion sites is examined. Development of this system is discussed through economic viability, design feasibility, and energy storage and conversion techniques. A W H

**N79-30727#** Illinois Univ at Urbana-Champaign Energy  
Research Group

**ENERGY AND LABOR INTENSITIES PROJECTED TO THE YEAR 2010**

Bruce Hannon and Andrew R Pleszkun DoE Sep 1978 163 p refs

(Contract EM-78-S-02-4628)

(COO-4628-2) Avail NTIS HC A08/MF A01

Total (direct and indirect) energy and labor intensities were projected to the year 2000 for a 40-sector economy. Energy intensities were derived by modifying the CONAES results with four possible energy price change scenarios between 1975 and 2010. Labor intensities were projected using data from the CAC model and projected BLS materials to approximate the effect of a doubling of energy prices between 1975 and 2010. As an example, the projected data were used to determine the net energy and employment impacts of the National Energy Plan on residential energy use to the year 2000. K L

**N79-30728#** Brookhaven National Lab., Upton, N Y  
**FUEL CELLS: APPLIED RESEARCH FUEL CELL MATERIALS**  
**AND ELECTROCATALYSIS Annual Report, 1 Jan. - 31 Dec. 1977**

S Srinivasan, H S Isaacs, W E Ogrady, P G Russell, H Olender, C R Davidson, L J Olmer, and A C C Tseung Dec 1978 39 p refs

(Contract EY-76-C-02-0016)

(BNL-50951) Avail NTIS HC A03/MF A01

The electrocatalysis of fuel cell reactions is examined with emphasis on the inhibition of sintering of fuel cell catalyst particles, electrochemical methods for surface regeneration, and the use of oxides as oxygen electrodes. Overpotentials in solid electrolyte fuel cells are analyzed and methods for the selection and evaluation of interconnector materials are discussed. A R H

**N79-30729#** Comptroller General of the United States,  
Washington, D C

**IMPROVED ENERGY CONTINGENCY PLANNING IS**  
**NEEDED TO MANAGE FUTURE ENERGY SHORTAGES**  
**MORE EFFECTIVELY**

10 Oct 1978 65 p

(EMD-78-106) Avail NTIS HC A04/MF A01

The Federal, State, and industry efforts in preparing for coping with energy emergencies are reported. The development and accuracy of the unemployment estimate announced by the Department of Energy during the 1977-78 coal strike are addressed. Recommendations to the Secretary of Energy and the Chairman of the Federal Energy Regulatory Commission are pointed out. M M M

**N79-30730#** European Space Agency, Paris (France)

**PHOTOVOLTAIC GENERATORS IN SPACE**

K Bogus, ed and T D Guyenne, ed Nov 1978 344 p refs  
Proc of 1st European Symp on Photovoltaic Generators in Space, Noordwijk, Neth., 11-13 Sep 1978

(SP-140) Avail NTIS HC A15/MF A01

A series of lectures was given including, as main topics, solar cell technology, module and blanket technology, design analysis and verification, interface problems, evolution of photovoltaics, solar power satellites, solar arrays, and test results as well as flight data

**N79-30732#** AEG-Telefunken, Wedel (West Germany)

**SPACE APPLICATION OF LARGE AREA TERRESTRIAL SOLAR CELLS FOR MULTI-KW-ARRAYS**

H Bebermier /in ESA Photovoltaic Generators in Space Nov 1978 p 7-14 refs

Avail NTIS HC A15/MF A01

Future development activities in the field of space silicon solar arrays were studied, considering the applicability of low cost photovoltaic solar arrays for terrestrial use. Investigations indicate that large area solar cells represent an optimum solution due to technology and cost reductions for large area solar arrays of the post Spacelab mission. Author (ESA)

**N79-30736#** AEG-Telefunken, Wedel (West Germany)

**SOME CURRENT DEVELOPMENTS IN SOLAR ARRAY TECHNOLOGY AT AEG-TELEFUNKEN**

J Koch /in ESA Photovoltaic Generators in Space Nov 1978 p 33-40 refs Sponsored by Bundesmin fuer Forsch u Technol

Avail NTIS HC A15/MF A01

Techniques applicable to solar generators with advanced requirements were developed, including repair technique for welded solar cells on a single cell basis, the space qualification of a new low outgassing silicon adhesive for solar cell bonding, and a solar cell interconnector design with extended fatigue lifetime, made by etching on silver foil. Author (ESA)

**N79-30745#** Messerschmitt-Boelkow-Blohm G m b H, Otto-brunn (West Germany) Space Div

**A EUROPEAN LOW-COST SOLUTION FOR SPACELAB POWER AUGMENTATION**

D E Koelle /in ESA Photovoltaic Generators in Space Nov 1978 p 101-105

Avail NTIS HC A15/MF A01

The design approach and the capabilities of the Spacelab Power Augmentation System (SPAS) Power Module are examined in relation to possible improvements of the Spacelab capabilities. A modular shuttle payload support structure is used, consisting of tubular carbon fiber composite truss elements, spanning the shuttle cargo bay. One specific application in combination with the ultra light platform (ULP) solar array is described which can serve as a power augmentation module for European Spacelab flights. In this case a two element SPAS structure should be used in combination with the hybrid or simingrid ULP flatpack array with a panel size of 3.3 x 1.1 m. The pallet structure is designed for installation above the Spacelab access tunnel, thus not demanding additional cargo bay length. Author (ESA)

**N79-30746#** National Aeronautics and Space Administration, Washington, D C Space Power Systems Branch

**THE NASA SPACE POWER TECHNOLOGY PROGRAM**

J P Mullin /in ESA Photovoltaic Generators in Space Nov 1978 p 107-111

Avail NTIS HC A15/MF A01

The objective and planning of the NASA space power research and technology program are reviewed. The areas of research covered include photovoltaic energy conversion, chemical energy conversion and storage, thermal to electric conversion, environmental interactions and power systems management of distribution. Author (ESA)

**N79-30747#** European Space Agency, Noordwijk (Netherlands)

**REVIEW OF EUROPEAN SOLAR ARRAY TECHNOLOGY AND POTENTIAL FUTURE DEVELOPMENTS**

K K Reinhartz /in ESA Photovoltaic Generators in Space Nov 1978 p 113-118 refs

Avail NTIS HC A15/MF A01

A review of the European solar array technology status considering both ESA and nationally funded developments is presented. Deployable rigid solar arrays as well as flexible roll-out and fold-out arrays and the major components of solar arrays are included. It is expected that in the future, advanced solar array technologies will be needed for television broadcast satellites, earth resources satellites, and shuttle launched and tended spacecraft. The technology for the first two mission types is believed to either exist or to be under development already. The design, development, and manufacture of solar arrays for future Shuttle missions, which may require from 50 to 250 kW array power, will represent a major technical challenge if Europe should decide to develop the necessary technology. Author (ESA)

**N79-30748#** British Aerospace Dynamics Group, Bristol (England)

**A STUDY ON SOLAR ARRAYS FOR PROGRAMMES LEADING FROM THE EXTENSION OF SPACELAB TOWARDS SPACE PLATFORMS**

P R C Gillett /in ESA Photovoltaic Generators in Space Nov 1978 p 119-129 refs Sponsored by ESA

Avail NTIS HC A15/MF A01

A review of a mission scenario covering the period from 1982 to the end of the century is presented, including some preliminary solar array concepts. These concepts range from the augmentation of Spacelab by 6 kW arrays through Power Module and Space Platform arrays along with Pilot Power Plants, to a brief examination of 10 GW Space Solar Power Stations. The second phase of the study concentrates on concepts for a 50 kW Orbiter mounted array, a 55 kW Power Module array, and two types of 2.50 kW Space Platform arrays, these representing items of likely interest for European contributions to the near and medium term programs. Finally, an outline strategy for the implementation of these arrays is considered. Author (ESA)

**N79-30749\*#** Boeing Aerospace Co., Seattle, Wash

**SOLAR CELLS FOR SOLAR POWER SATELLITES**

H Oman /in ESA Photovoltaic Generators in Space Nov 1978 p 133-138 refs

(Contract NAS9-15196)

Avail NTIS HC A15/MF A01

The concept of a solar-cell array for a solar power satellite is developed to permit evaluation of its economic feasibility for generating power for delivery to public utilities on earth. Gallium arsenide solar cells were considered but it could not be assured that the world gallium resources could support constructions of two solar power satellites per year. Therefore for preliminary design an array blanket made from 5 by 10 cm silicon solar cells, 50 microns thick, and electrostatically bonded between borosilicate glass sheets was adopted. In annealing experiments, a radiated 50 microns thick cell was restored to its initial performance in a 500 C Solar-cell efficiency effects significantly the solar power satellite mass, which varies from 90,000 metric

tons for 20 percent cells to 120 000 metric tons for 12 percent cells The anticipated cost of delivered power, based on 1977 dollars, varies from 4 cents per kWh with 18 percent cells, to 5 cents per kWh for 12 percent efficient cells Author (ESA)

**N79-30750\*# Boeing Aerospace Co Seattle, Wash  
SOLAR POWER SATELLITES: THE ENGINEERING CHALLENGES**

G R Woodcock In ESA Photovoltaic Generators in Space Nov 1978 p 139-147

(Contract NAS9-15196)

Avail NTIS HC A15/MF A01

Certain elements of solar power satellite design and system engineering studies are reviewed analyzing solar power satellites as a potential baseload electric power source The complete system concept concept includes not only the satellites and their ground stations but also the space transportation for delivery of the satellites, piece by piece, into space, and the factories for their construction in space Issues related to carrying the solar power satellite concept from the present design study phase through implementation of actual hardware are considered The first issue category is environmental aspects of the SPS systems The second category of issues is the technology risks associated with achieving the necessary component and subsystem performances The third category includes the engineering issues associated with carrying out such a large scale project The fourth issue category is financial the funding required to bring such a project into being and the costs of the satellites and resulting cost of the power produced as compared to potential alternative energy sources Author (ESA)

**N79-30751# European Space Agency, Noordwijk (Netherlands)  
INTERFACE PROBLEMS ON AN SPS SOLAR ARRAY BLANKET**

D Kassing In ESA Photovoltaic Generators in Space Nov 1978 p 149-159 refs

Avail NTIS HC A15/MF A01

Starting from a survey of proposed photovoltaic Solar Power Satellite (SPS) configurations, the design trend of solar arrays applicable in an SPS development program is sketched out indicating physical and other interface problems of the solar array sub-system with adjacent sub-system and the space environment The nature of research and development program on SPS solar cell blankets is discussed and a list containing potential study tasks for the near future is presented The objective is to identify from a systems engineering of view, the limiting conditions and interface problems associated with the development and operation of large solar generator blankets to be used in SPS systems and to discuss the nature of the supporting research and technology program aimed at solving the mentioned interface problems Author (ESA)

**N79-30752# Technische Univ, Berlin (West Germany) Inst fuer Luft und Raumfahrt**

**MOSGEN A POTENTIAL EUROPEAN CONTRIBUTION IN DEVELOPING LARGE SOLAR GENERATORS SUITABLE FOR GROWING POWER LEVELS UP TO SPS-SYSTEMS**

J Ruth and W Westphal In ESA Photovoltaic Generators in Space Nov 1978 p 161-166 refs

Avail NTIS HC A15/MF A01

A potential development program for large solar generators in space which seems to be suited especially for European needs is discussed The cost of production and transport have to be reduced to a minimum by constructive and technological steps so that they become competitive power plants The concept or a modular collector system represents one steps in that direction The modular philosophy is easily transferable to different sizes and applications of solar generators leading to solar power satellites An evolutionary strategy of development helps to provide high economical benefit of the modular attempt compared to nonmodular separately developed alternatives This strategy

means governing the development process by feed back dynamic optimization Author (ESA)

**N79-30757# Messerschmitt-Boelkow-Blohm G m b H, Otto-brunn (West Germany)**

**INTELSAT 5 SOLAR ARRAY**

H Brodersen and I Rizos In ESA Photovoltaic Generators in Space Nov 1978 p 209-217 refs

Avail NTIS HC A15/MF A01

The INTELSAT 5 solar arrays are described The solar array provides the primary energy source for the first three-axes-stabilized INTELSAT spacecraft, which is designed to satisfy INTELSAT communication requirements for the Atlantic, Pacific and Indian Ocean regions The solar array is designed to provide approximately 1.2 kW continuously at synchronous orbit for a seven year orbital lifetime The electrical and a mechanical design of the INTELSAT 5 solar array is discussed The results of specific development tests performed are presented Also included are the results of the cover integrated cell tests performed on selected solar cell samples Author (ESA)

**N79-30766# Centre National d'Etudes Spatiales, Toulouse (France)**

**BEHAVIOR OF SOLAR GENERATORS IN LOW ORBITS [COMPOTEMENT DE GENERATEURS SOLAIRES EN ORBITE BASSE]**

E duTrieu In ESA Photovoltaic Generators in Space Nov 1978 p 287-292 In FRENCH

Avail NTIS HC A15/MF A01

The performance of the identical generators carried by the D2B and the Signe 3 satellites was analyzed and compared The current supplied (1 sub GS) was very close in both cases although the orbits of the satellites have been very different After 200 days of orbital life the 1 sub GS degraded about 8% The law of variation is logarithmic with time As regards temperature, there is good agreement between theory and the results telemetered from Signe 3 No evidence can be given for the development of the the mo-optical characteristics of the generators Transl by A R H

**N79-30770# Johns-Manville Sales Corp, Denver, Colo Research and Development Center**

**PERFORMANCE AND EVALUATION OF CONCEPTS AND DEVICES FOR HEAT RECLAMATION FROM AIR CONDITIONERS, HEAT PUMPS, AND REFRIGERATION EQUIPMENT Final Report**

S S Mohammadi (Colorado School of Mines) and E D Sloan (Colorado School of Mines) Aug 1978 43 p refs

(Contract DAAK70-78-D-0002)

(AD-A069650 USAFESA-TSD-2057)

Avail NTIS

HC A03/MF A01 CSCL 13/1

A heat recovery system is described which uses air conditioner or heat pump waste heat for domestic water heating Current commercial units and field test data are detailed with economic guidelines to aid in choice of a unit This report enables the reader to determine the cost effectiveness of having such a unit installed Safety product warranty and city and state coding restrictions are discussed The current and future testing and demonstration plans are cited for the unit GRA

**N79-30771# Market Facts, Inc Washington D C**

**SMALL WIND ENERGY FOCUS GROUP RESULTS**

1978 43 p

(Contract EV-78-C-01-6458)

(DOE/TIC-10018) Avail NTIS HC A03/MF A01

The potential for commercialization of small wind energy was evaluated The barriers to development of this resource were determined Actions required by the Federal Government to promote commercialization were also determined DOE

**N79-30772# Sandia Labs Albuquerque N Mex**

**SOME VARIABILITY STATISTICS OF AVAILABLE WIND POWER**

J W Reed Mar 1979 50 p refs

(Contract EY-76-C-04-0789)

(SAND-78-1735) Avail NTIS HC A03/MF A01

The long-term variability of available wind power was studied in ten-year records of hourly wind speed observations at fifteen selected weather stations. Month by month and year by year sums of wind power occurrences were used to generate average, standard deviation, and autocorrelation statistics. The amplitude of the annual cycle in available wind power was at least 70% of the average at all locations. Long term integrated power production showed maxima and minima that differed by 36 to 91% from average annual production. DOE

**N79-30773# Sandia Labs., Albuquerque, N Mex  
ECONOMIC OVERVIEW OF VERTICAL AXIS WIND  
TURBINES**

W N Sullivan 1979 9 p Presented at the EPRI Wind-Energy Econ Workshop, Monterey, Calif., 27 Mar 1979

(Contract EY-76-C-04-0789)

(SAND-79-9733C, Conf-790352-1) Avail NTIS  
HC A02/MF A01

The class of vertical axis wind turbines (VAWT) investigated use curved fixed-pitch blades of constant section rigidly attached to a vertical rotating tower. Qualitatively, the main advantages of the VAWT over more conventional, propeller-type machines are the elimination of yaw controls, the placement of mechanical equipment at ground level, its amenability to simple, low-cost blade fabrication techniques, and aerodynamic stall characteristics which eliminate the need for active pitch control devices. The main disadvantages relative to modern propeller machines are a somewhat lower aerodynamic efficiency (about 10 percent lower), the limited ability of the rotor to self-start, and generally lower rotor operating RPM's, which leads to higher torque capacity requirements for the drive train. DOE

**N79-30774# TRW, Inc McLean, Va Energy Systems Planning  
Div**

**COST AND PERFORMANCE EVALUATION OF PASSIVE  
SOLAR SYSTEMS**

Nov 1978 68 p refs

(Contract W-31-109-eng-38)

(ANL/EES-TM-34) Avail NTIS HC A04/MF A01

This study was undertaken to produce a detailed methodology for designing optimal passive solar systems for single family residences. Earlier work showed that passive solar systems were economically more favorable than conventional HVAC systems. The earlier results were refined and a broader range of passive solar system configurations were examined in a wider variety of climate and insolation conditions. This study was divided into the following four major tasks: methodology development, refinement of cost and performance data, development of computer program, and analysis of thermal/storage walls. DOE

**N79-30776# Brookhaven National Lab., Upton, N Y  
ROLE OF THE VAPOR COMPRESSION CYCLE IN SOLAR  
ENERGY UTILIZATION**

Edward A Kush, Jr 1978 5 p refs Presented at Meeting of the Am Section of the Intern Solar Energy Soc., Denver, 28 Aug 1978

(Contract EY-76-C-02-0016)

(BNL-24573, Conf-780808-14) Avail NTIS  
HC A02/MF A01

The vapor compression cycle lends itself to solar energy utilization in two important ways. Its ability to utilize a relatively low temperature heat supply to produce space heating via heat pumps allows the use of solar input to the evaporator to provide potential coefficients of performance which are 2 to 3 times higher than present electric driven heat pumps, and the use of relatively inexpensive solar collectors is possible since the collection temperatures can be low grade. Secondly, the compression process of the vapor cycle can be powered by a solar-driven heat engine typically using a Rankine cycle, for solar cooling purposes. Discriminating coupling of solar with vapor compression allows the well-developed technology and manufacturing capability of the vapor compression industry to be brought

into play in the solar field, widening its base and promoting its diversification. The cycle thermodynamics, potential practical hardware, and R and D projects in both of these areas are reviewed. Particular attention is given to the solar assisted heat pump and its characteristics and the heat pump simulator activities at Brookhaven National Laboratory. DOE

**N79-30777# Wayne State Univ., Detroit, Mich  
CUPROUS OXIDE PHOTOVOLTAIC CELLS**

Dan Trivich, E Y Wang, R J Komp and A S Kakar 1978 5 p refs Presented at the IEEE Photovoltaic Specialists Conf., Washington, D C., 5 Jun 1978

(Contract ET-78-S-02-4726)

(CONF-780619-16) Avail NTIS HC A02/MF A01

Cuprous oxide, with a band gap of 2.0 eV, is an attractive material for solar cells because of low cost and great availability. The current conversion efficiency is 1 percent, but theoretical estimates are greater than 13 percent. For various Schottky barriers, e.g., Al/Cu<sub>2</sub>O, it is proposed that the V<sub>sub</sub> oc/ is limited by chemical conversion of the junctions to Cu/Cu<sub>2</sub>O junctions and the model is supported by Auger and ESCA results. It is proposed to avoid the reaction by use of an oxide interlayer as in Al/Al<sub>2</sub>O<sub>3</sub>/Cu<sub>2</sub>O, which also gives an MIS structure, but only minimal success has yet been achieved with the methods tried. Sb<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub>/sub x/ layers were explored. Another approach could be to use oxide heterojunctions on Cu<sub>2</sub>O. Several were explored and ZnO/Cu<sub>2</sub>O was best. In and Cd are effective dopants for Cu<sub>2</sub>O. With samples annealed at 500 C, diffusion lengths of approximately 4 micron were measured by an SPV method. The spectral sensitivity of Cu/Cu<sub>2</sub>O cells has a threshold at 630 nm and a maximum at 500 nm. DOE

**N79-30778# California Univ., Berkeley Lawrence Berkeley  
Lab**

**STRUCTURE OF A BLACK CHROME SOLAR SELECTIVE  
SURFACE**

Carl M Lampert Jul 1978 6 p refs Presented at the Meeting of the Am Section of the Intern Solar Energy Soc., Denver, Colo., 28 Aug 1978

(Contract W-7405-eng-48)

(LBL-6691-Rev, Conf-780808-11) Avail NTIS  
HC A02/MF A01

The structure of Chrom-Onyx type of black chrome/metal selective absorber was studied to gain a better understanding of its influence upon the mechanisms of wavelength selectivity. Spectral reflectance measurements were performed on seven samples. The best selectivity was found by these measurements to be 0.7 micron of black chrome on nickel and 1.0 micron of black chrome on copper. Both scanning and transmission electron microscopy were employed to study microstructure and chemical composition. As a result of the combined studies, some effects of black chrome thickness and the metallic substrate were determined. It was found that black chrome consisted of a very fine metallic distribution of particles of chromium, possibly suspended within a matrix of an oxide of chromium. This combination was, in turn, agglomerated into larger particles within 0.05 to 0.3 micron size range. These larger particles formed a network which constituted the surface coating. DOE

**N79-30779# California Univ., Berkeley Lawrence Berkeley  
Lab**

**ENERGY UTILIZATION ANALYSIS OF BUILDINGS**

M Lokmanhekim Jun 1978 20 p refs Presented at the Symp on Solar Energy Cairo 16 Jun 1978

(Contract W-7405-eng-48)

(LBL-7826, Conf-780667-4) Avail NTIS HC A02/MF A01

The accurate calculation of the energy requirements and heating and cooling equipment sizes for buildings is one of the most important, as well as one of the most difficult problems facing the engineer. The fundamental principles utilized in the procedures developed by American Society of Heating, Refrigerating and Air-Conditioning Engineers are explained and brief descriptions of the computer programs using these procedures are given. Such computer programs generally are capable of simulating the thermal response of a building to all sources of heat gains.



and losses, accounting for all nonthermal energy requirements in the building or on the sites, translating the building operating schedules into energy demand and consumption, identifying the peak capacity requirements of heating and cooling equipment, and performing an economic analysis that would select the most economical overall owning and operating cost equipment and energy source that minimize the building's life cycle cost DOE

**N79-30780#** Sandia Labs., Albuquerque, N Mex  
**STATUS OF THE DOE PHOTOVOLTAIC SYSTEMS ENGINEERING AND ANALYSIS PROJECT**  
 G J Jones and D G Schueler 1978 6 p refs Presented at the IEEE Photovoltaic Specialists Conf., Washington, D C, 5 Jun 1978  
 (Contract EY-76-C-04-0789)  
 (SAND-78-0955C, Conf-780819-14) Avail NTIS HC A02/MF A01

The economic viability of photovoltaic power systems depends not only on the reduction of photovoltaic array prices but also on the realization of acceptable total installed system price. The allowable total installed system price is calculated for various major application sectors, based on a range of projected leveled energy costs. These allowable prices are then compared to projected prices which are obtained by examining the current and future expected prices of the major subsystems comprising an operational system. Based on this comparison an assessment of the status of the major subsystem technologies, exclusive of the photovoltaic array, is given and areas requiring emphasis are identified DOE

**N79-30781#** Argonne National Lab., Ill  
**RELIABILITY, MAINTAINABILITY, AND MATERIALS PERFORMANCE OF SOLAR DEMONSTRATION SYSTEMS**  
 Prem S Chopra 1978 9 p Presented at the Conf on the Energy Solar Updates, Atlanta, 12 Jul 1978  
 (Contract W-31-109-eng-38)  
 (ANL/EES-CP-14, Conf-780701-1) Avail NTIS HC A02/MF A01

The Department of Energy is conducting the National Program for Solar Heating and Cooling of Buildings. A major element of that program is the National Solar Data Program which includes data collection, evaluation and report publication. Information and technical data are being collected and reported on a number of residential and commercial sites. Recently, a program was initiated at Argonne National Laboratory (ANL) under the auspices of the National Solar Data Program to collect, evaluate, and publish reliability, maintainability, and material performance data from these sites. The plans which have been made and some of the early results which can be expected from the ANL Solar Data Program are described DOE

**N79-30782#** Los Alamos Scientific Lab., N Mex  
**COMPARATIVE ECONOMICS OF PASSIVE AND ACTIVE SYSTEMS**  
 J F Roach, S A Noll, and S Ben-David 1978 41 p refs Presented at the Intern Symp Workshop on Solar Energy, Cairo, 16-22 Jun 1978  
 (Contract W-7405-eng-36)  
 (LA-UR-78-1878, Conf-780667-3) Avail NTIS HC A03/MF A01

As the interest in solar energy applications for residential space heating grows, it becomes imperative to evaluate the economic performance of alternative designs. One passive design is concentrated on the thermal mass storage wall. The economic performance of this design is examined and subsequently contrasted with one active design—the air collector/rock storage system. Architectural design criteria, solar performance characteristics, and the incremental solar cost of each design is briefly reviewed. Projections of conventional energy prices are discussed, along with the optimal sizing/feasibility criterion employed in the economic performance analysis. In addition, the effects of two incentive proposals—income tax credits and low interest loans—upon each design are examined. Results are reported on a state-by-state basis for the U.S., with major conclusions summarized for each design. It is generally the case that incentives

greatly enhance the economics of both system designs, although the contrast is greater for the passive design. Also, against the less expensive conventional fuels (natural gas and heating oil) the passive design was shown to offer a more cost effective alternative than the active system for most states DOE

**N79-30784#** Sandia Labs., Albuquerque, N Mex  
**LINEAR CONCENTRATING SOLAR COLLECTORS. CURRENT TECHNOLOGY AND APPLICATIONS**  
 James A Leonard Jul 1978 36 p refs  
 (Contract EY-76-C-04-0789)  
 (SAND-78-0949) Avail NTIS HC A03/MF A01

Linear concentrating collector technology is reviewed. Included are fundamentals of the technology, descriptions of collectors with particular emphasis on the types tested at the DOE/Sandia Midtemperature Solar Systems Test Facility (MSSTF), performance test results, problems identified through operating experience, cost projections, and a discussion of applications of linear concentrating and midtemperature solar collectors DOE

**N79-30785#** Department of Energy, Washington, D C Div of Solar Applications Developments  
**NATIONAL SOLAR HEATING AND COOLING COMMERCIAL DEMONSTRATION PROGRAM: KEY PERSONNEL DIRECTORY**  
 Jan 1979 152 p  
 (DOE/CS-0057) Avail NTIS HC A08/MF A01

Firms and individuals who are principal participants in The Department of Energy (DOE) solar heating and cooling demonstration projects for Federal and non-Federal commercial buildings are identified. This directory is intended to facilitate communication with and among active participants in demonstrations of solar heating and cooling technology currently sponsored by DOE. The listing provides identification for several participants in each active DOE commercial demonstration project. When available, identifying information is provided for owners, architects, solar designers, mechanical engineers, builders, and other key personnel directly involved in each project DOE

**N79-30786#** Battelle Pacific Northwest Labs., Richland, Wash  
**ENERGY-INTENSIVE INDUSTRY FOR ALASKA. VOLUME 1. ALASKA COST FACTORS, MARKET FACTORS, SURVEY OF ENERGY-INTENSIVE INDUSTRIES. Final Report**  
 W H Swift, M Clement, E G Baker, D C Elliot, J J Jacobsen, T B Powers, C A Rohrmann, and G L Schiefelbein Sep 1978 267 p refs 3 Vol  
 (Contract EY-77-C-06-1002-001)  
 (TID-29025/1) Avail NTIS HC A12/MF A01

The Alaskan and product market factors influencing industry locations in the state are described and a survey of the most energy-intensive industries is presented. Battelle analyzed the factors external to Alaska that would influence development and the cost of energy and labor in Alaska. This volume covers the industries likely to be drawn to Alaska because of its energy resources and analyzes these in terms of (1) cost of using Alaska energy resources in Alaska as apposed to the Lower 48, (2) skill-adjusted wage and salary differentials between relevant Alaskan areas and the Lower 48, and (3) basic plant and equipment and other operating-cost differentials between relevant Alaskan areas and the Lower 48. This report also develops an understanding of the likely level at which development might take place and its timing. Industries that will tend to locate in Alaska as a result of energy consideration are listed, in order of merit: lime, aluminum, portland cement, methanol, carbon black, ammonia, and chlorine industries DOE

**N79-30787#** Battelle Pacific Northwest Labs., Richland, Wash  
**ENERGY INTENSIVE INDUSTRY FOR ALASKA VOLUME 2: CASE ANALYSIS. Final Report**  
 Kent Miller Sep 1978 107 p refs 3 Vol  
 (Contract EY-77-C-06-1002-001)  
 (TID-29025/2) Avail NTIS HC A06/MF A01

Volume 1 evaluated a number of energy industries that might be attracted to the state as a consequence of the availability of its large and diversified sources of primary energy. However, it

was concluded that of all industries examined, the primary aluminum metal industry (the most energy-intensive) appeared to be the most likely to succeed in Alaska, assuming the future availability of a large block of low-cost hydropower. It was further concluded that, due to the trends in the domestic and worldwide aluminum industry and markets and the potential implications, a large electroprocess industry would have to interphase with Alaska's electric-power-supply planning, so, a more detailed analysis of that industry's potential was warranted. The aluminum industry is examined in detail as a model locational analysis of an industry along with the environmental, economic, and electric-power implications. DOE

**N79-30788#** Battelle Pacific Northwest Labs., Richland, Wash  
**ENERGY-INTENSIVE INDUSTRY FOR ALASKA.**  
**VOLUME 3. BACKGROUND DATA**

Kent Miller Sep 1978 320 p refs Prepared in cooperation with Alaska Univ., Anchorage 3 Vol  
 (Contract EY-77-C-06-1002-001)

(TID-29025/3) Avail NTIS HC A14/MF A01

Background data are summarized on evaluating energy-intensive industry for Alaska covering objectives, available infrastructure, and possible future economic growth. Catalogs are presented of energy, mineral, and renewable natural resources on which industrial development may be based. DOE

**N79-30790#** Argonne National Lab., Ill Fusion Power Program

**FUSION ENERGY FOR ALTERNATIVE APPLICATIONS. THE GENERATION OF SYNTHETIC GASEOUS FUELS** Interim report

Jan 1979 110 p refs  
 (Contract W-31-109-eng-38)

(ANL/FPP/TM-117) Avail NTIS HC A08/MF A01

Methods for generating synthetic fuels from the high temperature process heat produced by fusion reactors is discussed. A high temperature fusion reactor blanket design is presented which has the capability to produce process heat in excess of 1000 C, eliminates ceramics as structural materials in the reactor, and is self sustaining with respect to tritium breeding. AWH

**N79-30791#** Elrick and Lavidge, Inc., San Francisco, Calif  
**GEOTHERMAL/HYDROTHERMAL ENERGY GROUP INTERVIEW**

1 Aug 1978 14 p  
 (Contract EV-78-C-01-6457)

(DOE/TIC-10030) Avail NTIS HC A02/MF A01

A group interview conducted on geothermal/hydrothermal (liquid dominated) energy suitable for generating electricity and/or direct heat applications was analyzed. The group was composed of representatives of the following types of organizations: electric utilities, geothermal developers, industrial process heat users, engineering consultants, equipment manufacturers, environmentalist, regulatory commission and financial institutions. The analysis was divided into four subjects: commercial feasibility, future market potential, the relative importance of barriers to commercialization, and the proper role of the Federal Government. DOE

**N79-30792#** Colorado Univ., Boulder Dept of Mechanical Engineering

**MODELING HEAT AND MASS TRANSFER AT THE MESA GEOTHERMAL ANOMALY, IMPERIAL VALLEY, CALIFORNIA** Final Report

D R Kassoy and K P Goyal Feb 1979 175 p refs.  
 (Contract W-7405-eng-48)

(LBL-8784) Avail NTIS HC A08/MF A01

The geothermal reservoir modeling effort is reviewed and technical accomplishments during the final funding period are described. It is concluded that a physically viable mathematical model of an unexploited geothermal system can be constructed in terms of the fault zone controlled charging of the thermally active section of a reservoir. DOE

**N79-30793#** Barber-Nichols Engineering Co., Arvada, Colo  
**GEOTHERMAL PUMP TEST FACILITY** Final Report, Jul 1977 - Jul 1978

R W Blakemore Sep 1978 16 p

(Contract EY-76-C-04-3715)

(ALQ-3715-1) Avail NTIS HC A02/MF A01

The design configuration and fabrication of a transportable geothermal pump test facility are described. The test facility, consisting of a test rig and data acquisition system trailer, provides the user with the unique opportunity to develop and calibrate geothermal pumps with less liability and risk and at lower cost than would be incurred by actually installing the pump in a geothermal well. Pump tests may be performed using either domestic water, heated by pumping energy or by using actual geothermal brines supplied directly to the test rig which would be located adjacent to the well. The geothermal pump test facility is completely self supporting and requires only an electrical supply source to become fully operational. DOE

**N79-30795#** Oak Ridge National Lab., Tenn  
**ECONOMY OF A RETROFIT SOLAR SYSTEM**

J M Schreyer 1979 20 p ref Presented at the 6th Energy Technol Conf and Exposition, Washington, D C, 26 Feb 1979

(Contract W-7405-eng-26)

(CONF-790213-2) Avail NTIS HC A02/MF A01

The use of 8 flat plate collectors each 10 sq ft for the solar water system retrofitted on a 20 year old house is presented. A 50/50 glycol/water fluid was circulated through the collector circuit. A 120 gal galvanized water tank was used for storage. An economic analysis of the hot-water system is presented. DOE

**N79-30796#** Logistics Management Inst Washington, D C  
**INTERNATIONAL ENERGY EVALUATION SYSTEM VOLUME 2: TECHNICAL DOCUMENTATION, SEPTEMBER 1, 1978**

M L Shaw and B J Allen Mar 1979 277 p

(Contract EC-77-C-01-8602)

(HCP/L8602-01/2) Avail NTIS HC A13/MF A01

A model was developed to analyze the impact of various national and international policies on energy flows between the U.S. and the rest of the world. This model forecasts equilibrium levels and prices for a typical day in 1985 and 1990. The modeling structure and its objectives are described. The demand for energy in the U.S., the other Organization for Economic Cooperation and Development countries, and the non-OECD regions—each of which is analyzed using different modeling approaches—are discussed. The supply of primary energy materials, their transportation to consuming regions, and their conversion to final demand products are examined. The mathematical formulation of the problem and how the supply, transportation, conversion, and demand activities are combined to produce an equilibrium is presented. DOE

**N79-30797#** Logistics Management Inst Washington, D C  
**ENERGY SECTOR CAPITAL REQUIREMENTS, 1978-1985**

Jan 1979 64 p Sponsored by DOE

(DOE/EIA-0103/24) Avail NTIS HC A04/MF A01

The approach used, and the values derived, to estimate capital requirements for the energy sector of the U.S. economy for the period 1 Jan 1978 to 1 Jan 1985 are described. The capital requirements of the energy supply industries needed to produce the energy equilibrium levels projected to 1985 are discussed. The capital requirements estimates for the major energy subsectors and three supply/demand scenarios are summarized. Energy subsectors addressed include oil and gas production and refining, coal, electric utilities (including nuclear generation), and the advanced technologies (solar, geothermal, wind, and synthetics). DOE

**N79-30799#** Department of Energy, Washington, D C Energy Information Administration

**SHORT-TERM PROJECTIONS OF THE ENERGY SUPPLY AND DEMAND IN THE UNITED STATES FROM THE EIA REPORT TO CONGRESS, 1977 Annual Report**

Dec 1978 108 p

(DOE/EIA-0102/37) Avail NTIS HC A06/MF A01

Short-term energy projections obtained using the data, industry expertise and computer-based forecasting models are presented. United States domestic consumption of gross energy inputs (not accounting for generation and transmission losses) projected to grow from 73.7 quadrillion BTU (quads) in 1976 to 79.6 quads by 1979, an increase of about 2.6% per year, accelerating somewhat from the 1970-1976 growth rate of about 1.8%. This assumes a mid-range projections of economic activity. A low growth assumption yields a 1979 domestic consumption figure of 79.2 quads (2.4% growth) and the high demand assumption yields consumption of 81.9 quads (3.6% growth rate). The major factors affecting demands and supplies, the ranges of the forecasts, the sensitivity of the forecasts to significant uncertainties, and comparisons with other relevant forecasts are presented. DOE

**N79-30801\*** Boeing Engineering and Construction, Seattle, Wash

**APPLICATIONS OF THERMAL ENERGY STORAGE TO PROCESS HEAT STORAGE AND RECOVERY IN THE PAPER AND PULP INDUSTRY. Final Report, Sep 1977 - May 1978**

J H Carr, P J Hurley, and P J Martin Sep 1978 244 p refs. Sponsored by NASA  
(Contracts EC-77-A-31-1034, EC-77-C-01-5082)  
(NASA-CR-159398, CONS-5082-1) Avail NTIS  
HC A11/MF A01 CSCL 10C

Applications of Thermal Energy Storage (TES) in a paper and pulp mill power house were studied as one approach to the transfer of steam production from fossil fuel boilers to waste fuel (hog fuel) boilers. Data from specific mills were analyzed, and various TES concepts evaluated for application in the process steam supply system. Constant pressure and variable pressure steam accumulators were found to be the most attractive storage concepts for this application. DOE

**N79-30802#** California Univ., Berkeley Lawrence Berkeley Lab

**ENERGY USE AND CONSERVATION IN INDUSTRIALIZED COUNTRIES**

L Schipper Nov 1978 46 p refs. Presented at the Conf on Energy Productivity, New York, 2 Nov 1978  
(Contract W-7405-eng-48)  
(LBL-7872, Conf-781124-1) Avail NTIS HC A03/MF A01

Economic factors influencing energy use and development energy saving technology in industrialized countries are discussed. International comparisons of energy use show that there is much technical flexibility and conservation potential within present U.S. energy use patterns, and in other countries, provided that economic incentives and time are allowed to play a role. Energy use policies per se are of a secondary nature in the establishment of today's practices, but policies will be more important in the future. Energy consumption in the U.S. is compared with that in Sweden. DOE

**N79-30803#** Argonne National Lab III  
**EVALUATION OF SELECTED NEAR-TERM ENERGY-CONSERVATION OPTIONS FOR THE MIDWEST**

A R Evans, C S Colsher, R W Hamilton, and W A Buehring Nov 1978 172 p refs  
(Contract W-31-109-eng-38)  
(ANL/EES-TM-41) Avail NTIS HC A08/MF A01

The potential for implementation of near-term energy conservation practices for the residential, commercial, agricultural, industrial, transportation, and utility sectors of the economy is evaluated for 12 states: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The information used to evaluate the magnitude of achievable energy savings includes regional energy use, the regulatory/legislative climate relating to energy conservation, technical characteristics of the measures, and their feasibility of implementation. Baseline information for an ongoing regional assessment of energy and environmental impacts in the Midwest is provided. DOE

**N79-30804#** California Univ Berkeley Lawrence Berkeley Lab Dept of Materials Science and Mineral Engineering  
**MICROSTRUCTURE AND OPTICAL PROPERTIES OF BLACK CHROME BEFORE AND AFTER EXPOSURE TO HIGH TEMPERATURES**

Carl M Lampert Jan 1979 15 p refs. Presented at the 2d Ann Conf on Absorber Surfaces for Solar Receivers Boulder Colo., 24 Jan 1979  
(Contract W-7405-eng-48)  
(LBL-8632, Conf-790120-2) Avail NTIS HC A02/MF A01

Short term high temperature heat treatments were used to simulate stagnation conditions. Samples were annealed in both air and vacuum which resulted in similar characteristics. Annealing in air appeared to mildly accelerate optical degradation at high temperatures. For short term heat treatments below 300 C the reflective and microstructural properties appeared to be unchanged. By in situ vacuum annealing of the coating above 400 C microcrystalline Cr2O3 was identified. By observation of diffraction patterns it was concluded that a Cr2O3 was transformed into crystalline Cr2O3. The Cr2O3 phase continued to grow at higher temperatures at the expense of chromium content. At temperatures above 500 C in vacuum a new phase identified as Cr3O4 formed. It was found that black chrome failed optically between 500 to 600 C for 1 hour heat treatments in both air and vacuum, also the coating heated in air failed mechanically by peeling at 600 C. DOE

**N79-30805#** Battelle Columbus Labs Ohio  
**DEVELOPMENT OF A LOW-TEMPERATURE, LOW-COST, BLACK-LIQUID SOLAR COLLECTOR**

D K Landstrom 1978 5 p refs. Presented at the 3d Solar Heating and Cooling R and D Branch Contractors Meeting Washington D.C., 24 Sep 1978  
(Contract EG-77-C-04-4097)  
(CONF-780983-14) Avail NTIS HC A02/MF A01

A cost effective, high efficiency low-temperature nonconcentrating black liquid type collector is presented. Whether this collector would have specific advantages when used as a thermal energy source for a heat pumps is analyzed. DOE

**N79-30806#** Sandia Labs Albuquerque N Mex Systems Analysis Div

**ANALYSIS OF COLLECTORS FOR PROCESS HEAT APPLICATIONS**

James K Linn Feb 1979 25 p refs  
(Contract EY-76-C-04-0789)  
(SAND-78-1977) Avail NTIS HC A02/MF A01

The economic viability of solar energy for industrial process heat applications depends directly on the collector array performance and cost. Various distributed solar collectors were evaluated in terms of solar availability, attainable performance and projected costs. Collectors were rank ordered in their projected cost effectiveness for future industrial process heat applications. DOE

**N79-30807#** Sandia Labs, Albuquerque, N Mex  
**GEOTHERMAL WELL TECHNOLOGY PROGRAM**

S G Varnado 1978 8 p refs. Presented at Workshop on Geothermal Drilling Fluids, Houston, Tex., 23 May 1978  
(Contract EY-76-C-04-0789)  
(SAND-78-1063 Conf-780580-1) Avail NTIS  
HC A02/MF A01

A program aimed at developing drilling and completion techniques for geothermal wells is presented. The reduction of well costs by 25% by 1982 and by 50% by 1986 is discussed. Program justification which relates well cost to busbar energy cost and to power-on-line goals is presented. Technological deficiencies encountered when current rotary drilling techniques are used for geothermal wells are discussed. A program for correcting these deficiencies is described. DOE

**N79-30808#** Argonne National Lab III  
**EFFECTS OF THE PROPOSED NEW SOURCE PERFORMANCE STANDARDS: A COMPARATIVE ASSESSMENT OF THE ENERGY AND ECONOMIC IMPACT**

Paul S Farber and C D Lvengood 1978 22 p refs Presented at the 71st Air Pollution Control Assoc Meeting, Houston, Tex., 25 Jun 1978

(Contract W-31-109-eng-38)

(ANL/EES-CP-6, Conf-780636-6)

Avail

NTIS

HC A02/MF A01

In order to study the effect of the proposed vis-a-vis existing, New Source Performance Standards (NSPS) a number of coal sources were chosen to adequately represent the various coal supply regions in the U S Power plant scenarios were chosen to reflect both the mine mouth type of power plant and the effects of interstate coal shipment Case studies were performed in order to determine the least cost mix of coal type and control techniques (particulate, FGD coal cleaning, and NO/sub x/) needed to meet present and proposed NSPS Costs and energy usage for environmental control were derived on an incremental basis with respect to a 500 MWe output base power plant

DOE

**N79-30809#** TRW, Inc., McLean, Va Energy Systems Planning Div

**METHODOLOGY FOR THE ANALYSIS OF INVESTMENT ALTERNATIVES TO STIMULATE DEVELOPMENT AND TECHNOLOGY TRANSFER FOR ENERGY TECHNOLOGIES**

Sep 1978 27 p refs

(Contract ET-78-C-05-5670)

(TID-28971) Avail NTIS HC A03/MF A01

The incentives to encourage the development and commercialization of selected energy technologies are examined through a final model A decision oriented approach was adopted in characterizing a typical company's response to implementation of a particular incentive This approach is described in detail A computer model that calculates net present values and internal rates of return for prescribed investments in manufacturing facilities is included

DOE

**N79-30810#** Thermo Electron Corp., Waltham, Mass  
**ENERGY CONSERVATION OPPORTUNITIES IN COMMERCIAL APPLIANCES Final Report**

J R Hurley Dec 1978 281 p refs

(Contract W-7405-eng-26)

(ORNL/Sub-7261/1) Avail NTIS HC A13/MF A01

A data base of energy consuming appliances in the commercial sector was established which identifies and rates the most promising development opportunities that would save significant amounts of energy on a national level A detailed national inventory of 45 major appliances and their energy consumption was established for the year 1975 Thirty-four potential appliance improvements were identified, evaluated, and ranked The major energy consuming appliances in the following functional use categories were identified, space heating and cooling, water heating, refrigeration, cooking, and lighting The equipment in these categories was estimated to consume 87% of the total energy used in the commercial sector, with the remaining 13% consumed by equipment such as computers, business machines, laundry equipment, dishwashing, and other food service equipment

DOE

**N79-30811#** District of Columbia Bar Association, Washington D C

**INTERNATIONAL ENERGY CONSERVATION COMPARATIVE LAW AND POLICY PROCEEDINGS FROM THE 1978 INTERNATIONAL CONFERENCE ON ENERGY CONSERVATION**

Feb 1979 362 p refs Conf held at Washington, D C, 23-24 Feb 1978, sponsored by DOE and Am Soc of Intern Law

(CONF-780274) Avail NTIS HC A16/MF A01

The policies and laws that highly industrialized nations have used and considered to meet the challenge of energy conservation were compared and discussed The following countries participated in the conference U K Australia, Federal Republic of Germany, Japan, France Canada Sweden, Italy, the Netherlands, and the U S The IEA and the Commission of the European Communities also participated The conference format consisted of ministerial addresses to the conference interspersed with panel discussions

focusing on energy conservation in transportation, industry, agriculture, and utilities, residential, commercial, and industrial buildings, and emergency situations There was also a panel discussion on the role of government in energy conservation and energy information collection The panels were composed of participating countries' representatives

DOE

**N79-30812#** Solar Systems of Virginia Inc., Hampton  
**COST EFFECTIVE SOLAR HOT WATER SYSTEM FOR ECONO-TRAVEL MOTOR HOTEL, CHESAPEAKE, VIRGINIA Final Report**

Dec 1978 17 p refs

(Contract EM-78-G-02-4663)

(COO-4663-1) Avail NTIS HC A02/MF A01

The final report of a cost effective solar hot water heating system is presented The description of the system along with the final breakdown performance data and payback time are given The payback time for the installed system will be approximately four years instead of the 6.65 years estimated for the proposal The additional savings is due to the reduction in the peak demand charge since the electric hot water heaters are not required to operate at the same time each morning as the dryers used for the laundry The results shown in the hotel's monthly electricity bills indicate that this goal has been accomplished

DOE

**N79-30813#** Department of Energy, Washington, D C Office of Conservation and Solar Applications

**COMMUNITY SYSTEMS PROGRAM**

Feb 1979 55 p refs

(DOE/CS-0072) Avail NTIS HC A04/MF A01

The Community Systems program of DOE through research, development, and demonstration will help communities develop and put into practice effective energy conservation programs To do this, the program develops and demonstrates approaches to community energy conservation that combine use of the energy resources available within a community reducing reliance on external and scarce fuels, increase the use of fuel-efficient energy systems in supplying utility services, substitute energy systems that use nonscarce fuels for those that consume oil and natural gas, and reduce the end-use demand for energy through planning and development practices A community is described here as any complex of buildings and open spaces used by large numbers of people and connected by networks for moving the people as well as messages goods and services Before energy conservation in communities can have a national impact, comprehensive energy management must become an integral part of community processes The Community Systems program is organized into three components--systems engineering products, planning and development products, and implementing mechanisms products The activities within each program element are presented followed by a discussion of current site-specific prototype application projects (grid-connected systems coal-using systems, district heating and cooling, heat pump systems, power plant retrofit, site design applications, subsystems development case studies, general development planning applications, and comprehensive community energy management pilot projects) Program management, organizational responsibilities, and budget are summarized The current program activities and significant milestones are described A list of publications resulting from Community Systems programs efforts is presented

DOE

**N79-30814#** Department of Energy, Washington, D C Office of State and Local Programs

**COMPREHENSIVE PROGRAM AND PLAN FOR FEDERAL ENERGY EDUCATION, EXTENSION AND INFORMATION ACTIVITIES Second Report to Congress**

Jan 1979 161 p refs

(Contracts EC-77-C-03-1446, EU-78-C-01-6280)

(DOE/CS-0071) Avail NTIS HC A08/MF A01

This second annual Comprehensive Program and Plan for Federal Energy Education Extension and Information Activities continues to survey federal outreach programs, to report on several considerations important to their effectiveness, and to provide a plan for their improved coordination It provides individual

Americans with the capability they need to adopt energy-saving measures. Outreach programs provide information and technical assistance tailored to communicate the importance of changes in energy consumption patterns, the energy and renewable-fuel options available, and the associated short-and long-term cost savings. Thirteen Federal departments and agencies have reported 68 programs dedicated in whole or in part to energy-outreach activities. They describe in detail these energy-conservation programs and the use of renewable fuels, address procedures for minimizing potential conflict of federal energy education, extension, and information activities with those offered by the private sector, the relationship of these activities to other federal assistance and incentive programs, and procedures for evaluating the effectiveness of federal energy education, extension, and information efforts. The final chapter presents a plan of action for the coming year through which increased coordination of federal energy education, extension, and information activities will be sought. DOE

**N79-30815#** Department of Energy, Washington D C Energy Information Administration

**PROJECTIONS OF ENERGY SUPPLY AND DEMAND FOR THE 1978-1979 WINTER HEATING SEASON**

David T Hulett Nov 1978 43 p refs

(DOE/EIA-0102/33) Avail NTIS HC A03/MF A01

National projections were made for petroleum, natural gas, and coal based on an economic assumption that reflects moderate growth in real GNP of 2.6 percent in 1979, normal weather conditions, and no major disruption in foreign or domestic supplies. Range of these projections based on legitimate real work uncertainties are presented. The projections showed that supplies together with realistic inventory drawdown strategies and feasible import levels would be adequate to meet the foreseen consumption requirements for all fuels for the winter, although there were some indications of possible tightness in the supply and demand balances for each major fuel. DOE

**N79-30816#** Department of Energy, Washington D C Office of Policy and Evaluation

**ROLE OF THE STATES IN ENERGY**

Sep 1978 42 p refs

(DOE/PE-0009) Avail NTIS HC A03/MF A01

Some 44 separate energy programs and policies which involve states, and are administered by 8 Federal departments are examined. Of these programs 17 received primary emphasis and were selected for further detailed study, and were divided into conservation programs/policies and supply programs/policies. Field studies in 8 selected Case Study States were selected so that they would be representative of the problems and opportunities associated with energy production and consumption. The states were Alabama, California, Colorado, Illinois, Massachusetts, Minnesota, New York, and Texas. The study approach described and analyzed state energy capabilities, existing problems and opportunities, and the Federal government's role in aiding and improving state energy capabilities. The range of Federal energy programs and policies is outlined, and the burdens these programs placed on the states are explored. DOE

**N79-30817#** Department of Energy Washington D C Energy Information Administration

**RECENT ENERGY CONSUMPTION TRENDS IN EUROPEAN ECONOMIC COMMUNITY COUNTRIES**

Mark Rodekohr Jan 1979 56 p refs

(DOE/EIA-0103/16) Avail NTIS HC A04/MF A01

A descriptive analysis of EEC energy consumption and production in the pre- and post-embargo period from 1973 to 1976 is provided. Primarily aggregate EEC data is presented, however some individual country data is shown to highlight some of the more important trends. Sectoral consumption is shown along with the appropriate measure of economic activity and other important indicators of energy consumption. From 1973 to 1975, net imports to the EEC declined by 140 metric tons of oil equivalent (MTOE) of which 75 MTOE was due to a decline in total energy requirements (TER) and the remaining 65 MTOE was due to an increase in indigenous production. The trends in TER are illustrated in a figure and table where the sectoral consumption levels are shown. DOE

**N79-30818#** California Univ Berkeley Lawrence Berkeley Lab

**ENERGY CONSERVATION POLICY ISSUES AND END-USE SCENARIOS OF SAVINGS POTENTIAL PART 6. END-USE ENERGY CONSERVATION DATA BASE AND SCENARIOS**

Sep 1978 398 p refs

(Contract W-7405-eng-48)

(LBL-7896-Pt-6) Avail NTIS HC A17/MF A01

End-use energy conservation scenarios discussed show the combined effect on energy consumption of implementing a number of conservation measures. The scenarios serve two overall purposes. First, they provide a contrast of a series of nonconservation cases based on assumption of growth rate and appliance saturation with conservation cases on similar assumptions. Second, they provide detailed data and documentation for the savings potential for each conservation measure, the stock affected, and the calculation of total energy savings. Included are conservation measures of both a behavioral nature and technological nature. Quantitative estimates of energy consumption and conservation potential in the major residential and commercial end uses, transportation modes, and industrial subsectors made. For each measure and for the total scenario a base case and a conservation case were computed. DOE

**N79-30819#** Iowa State Univ of Science and Technology, Ames Heat Transfer Lab

**ENERGY CONSERVATION VIA HEAT TRANSFER ENHANCEMENT Quarterly Progress Report, 1 Jul. - 30 Sep. 1978**

A E Bergles, G H Junkhan, and R L Webb Oct 1978 34 p refs

(Contract EG-78-S-02-4649)

(COO-4649-3) Avail NTIS HC A03/MF A01

Progress on the subject contract for the period July 1, 1978 to September 30, 1978, is discussed. Discussions with manufacturers of heat exchange equipment; as well as R and D personnel, were held in order to identify further examples of commercial equipment utilizing enhanced or augmented heat transfer. A listing of 127 manufacturers of enhanced heat transfer articles is presented. An additional 400 citations were added to the computerized file of literature. Many new full-size copies were obtained. The patent search has been continued, and progress has been made in identifying the patent classes and sub-classes of major interest. Summaries of preliminary work in two Key Application Areas are reported: waste heat recovery and sensible thermal energy storage. Key Technology Areas have also been identified, and preliminary reports on enhancement by free-stream turbulence and optimization of integral inner-fin tubes have been prepared. A number of other Key Areas have been identified. DOE

**N79-30822#** Argonne National Lab, Ill  
**PRELIMINARY EVALUATION OF THE USE OF HYDRAULIC AIR COMPRESSORS IN WATER-COMPENSATED RESERVOIR COMPRESSED AIR STORAGE POWER PLANTS**

F W Ahrens and J A Berghmans 1978 23 p refs Presented at CAES Technol Symp, Pacific Grove, Calif, 15 May 1978 (Contract W-31-109-eng-38)

(CONF-780599-2) Avail NTIS HC A02/MF A01

An air compression system for CAES applications, based on the hydraulic compressor principle, is described and evaluated. In addition to yielding a more efficient use of energy from the base power plant, due to isothermal air compression, the hydraulic air compressor does not require the conventional intercoolers and it replaces the air compressors with water pumps. Using performance characteristics predicted with an analytical model, a hydraulic compression system for a CAES plant is designed and compared with an equivalent conventional air compression system. The hydraulic air compressor-based CAES system uses less compression energy but can be costly due to the number and size of the water shafts required. DOE

**N79-30823#** Brookhaven National Lab, Upton, N Y  
**MULTIOBJECTIVE ANALYSIS IN A NATIONAL ENERGY SYSTEM MODEL**

Joseph Schank 1978 7 p refs Presented at 9th Conf on Modeling and Simulation, Pittsburgh, Pa, 27 Apr 1978

(Contract EY-76-C-02-0016)

(BNL-24371, Conf-780450-2) Avail NTIS HC A02/MF A01

An automated methodology for the analysis described is developed. Both the previous and automated procedures are executed upon a variant of the 1985 National Energy plan scenario and the respective results are compared. DOE

**N79-30824#** Pennsylvania Univ., Philadelphia  
**STATUS OF ENERGY-MANAGEMENT ACADEMIC PROGRAMS IN US INSTITUTIONS OF HIGHER EDUCATION: EXECUTIVE SUMMARY**

L Eisenberg, C Daspi, and G Shimamoto Sep 1978 29 p  
 (Contract EE-77-S-02-4465)

(COO-4465-2-Exec-Summ) Avail NTIS HC A03/MF A01

A formal course of study, leading to the bachelor's or higher degree, which addresses the range of energy management issues is described. Some 2,602 US institutions of higher education were surveyed in order to identify energy management programs and related courses. More detailed information was sought from respondents who indicated that they had, or planned to offer, such a program. Ten existing, and planned, programs were identified. In addition, 303 institutions were found to offer one or more courses on some aspect of energy management. The 10 existing programs were classified as undergraduate, engineering focused, or general/diversified. They were analyzed in terms of their administrative organization, enrollment and number of degrees awarded to date, availability of financial support for graduate students, program goals and curriculum design. DOE

**N79-30825#** Mathematica, Inc., Princeton, N J  
**ENERGY FROM URBAN WASTES: REPORT ON A FOCUS GROUP DISCUSSION**

W E Nicholson 10 Nov 1978 42 p

(Contract EV-78-C-01-6388)

(DOE/TIC-10022) Avail NTIS HC A03/MF A01

A qualitative assessment of the opinion concerning the commercialization potential of urban waste technologies is presented. Barriers to the commercialization of the urban waste energy production systems that were discussed include problems in serving long-term contracts, uncertainty about environmental laws, problems with the supply of refuse, disposal and use of residue, uncertainties about future tax laws, legal barriers, technical reliability, and citizen dissent. DOE

**N79-30826#** Lincoln Lab., Mass. Inst. of Tech., Lexington  
**SOLAR MODULE CURVE TRACER**

A R Milner 7 Feb 1979 22 p

(Contract EY-76-C-02-4094)

(COO-4094-35) Avail NTIS HC A02/MF A01

The solar module curve tracer, a hand portable, battery powered instrument, is used to measure the output I-V characteristics of a solar module in a solar cell array. A physical description of the instrument, operating procedure, and circuit theory are presented. DOE

**N79-30827#** Sandia Labs., Albuquerque, N Mex  
**METHODOLOGY FOR DETERMINING THE ECONOMIC FEASIBILITY OF RESIDENTIAL OR COMMERCIAL SOLAR ENERGY SYSTEMS**

Audrey M Perino Jan 1979 38 p

(Contract EY-76-C-04-0789)

(SAND-78-0931) Avail NTIS HC A03/MF A01

A methodology for analyzing the economic feasibility of solar energy systems based upon a life cycle costing criterion is presented. Both residential and commercial solar energy systems are included in the analysis. The analysis provides for a comparison between solar and conventional energy systems. DOE

**N79-30828#** Los Alamos Scientific Lab., N Mex  
**ECONOMIC PERFORMANCE: EVALUATIONS FOR SOLAR ENERGY**

James Frederick Roach and S A Noll 1979 11 p refs  
 Presented at the 6th Energy Technol Conf and Exposition, Washington, D C, 26 Feb 1979

(Contract W-7405-eng-36)

(LA-UR-79-901, Conf-790213-3)

Avail NTIS

HC A02/MF A01

The LASL/UNM economic performance methodology--computer code, is reported. The inputs, sets of evaluative procedures, and outputs associated with the methodology/code are discussed. Present status plus on going modifications to the various components are highlighted. The utility of the LASL/UNM code is demonstrated through illustrative examples. DOE

**N79-30831#** Electricite de France, Chatou Dept d Optimisation et Automatisation des Processus

**ENERGY ANALYSIS OF THE HELIO-THERMAL-ELECTRIC CONVERSION [ANALYSE ENERGETIQUE DE LA CONVERSION HELIO-THERMO-ELECTRIQUE]**

T S Trans Feb 1977 22 p In FRENCH

(P-77/P40/242) Avail NTIS HC A02/MF A01

A precise description of the relationship of the sun to the earth in terms of energy is given. The physical position of the sun for any point on the earth is specified. Optical concentration of solar energy is discussed. A system for solar heat conversion is outlined. Thermodynamic conversion of solar energy is also mentioned. Author (ESA)

**N79-30832#** Dornier-Werke G m b H, Friedrichshafen (West Germany)

**RATIONAL ENERGY UTILIZATION IN COKE-OVEN-PLANT OPERATIONS Final Report**

Lutz Trepte and Hermann Bankwitz Bonn Bundesmin fuer Forsch u Technol Dec 1977 209 p refs In GERMAN, ENGLISH summary

(Contract BMFT-ETS-400-A, DFVLR-BPT-03-E5-110A)

(BMFT-FB-T-77-72) Avail NTIS HCA10/MF A01, ZDI, Munich DM 43,45

The economic use of energy in coke-oven-plant operations is discussed. In the process of high temperature coking more than 880 percent the heat applied remains as sensible heat in coke and raw gas. Due to present practice in coke plants these amounts of heat have to be considered as energy losses. Technological processes such as dry quenching of coke or methods for heat-recycling from raw gas could save 430,000 Gcal of energy per year in an average sized plant. This energy could be reused internally or provided to external consumers. In the first case the specific energy consumption of a traditional coke-plant would drop by 1/3. Considering the quantitative coke production in the Federal Republic of Germany there are considerable amounts of energy not reused. Because of the concentration of coke production in some highly populated areas it can be favorable to exchange energy between coke-plants and industrial plants or to use the heat energy gained as waste heat from coke-plants in large heating systems (e.g. multi-building heating). Author (ESA)

**N79-30833#** Deutscher Naturschutzring, e V., Bonn-Oberkassel (West Germany)

**STATEMENT AND COMPARISON BETWEEN DIFFERENT STUDIES ON ENERGY REQUIREMENT Final Report**

Hans Hammer, Peter Schmidt-Burr, Heinz W. Simonett, and Erwin Deischl Bonn Bundesmin fuer Forsch u Technol Dec 1977 164 p refs In GERMAN, ENGLISH summary Prepared in cooperation with Wirtschaft u Infrastruktur G m b H und Co Planungs-Kg, Munich

(Contract BMFT-ET-5207-A)

(BMFT-FB-T-77-92) Avail NTIS HC A08/MF A01, ZDI, Munich DM 29,40

A comparison between two energy requirement investigations on new energy systems ordered by the German government as well as a statement on the results are presented. An analysis of the demand for long distance heat supply is included. Possibilities for energy conservation by a more efficient utilization of energy and the possible use of new sources of energy are shown. Author (ESA)

**N79-30834#** Engins Matra, Velizy (France) Automatisme Dept

**STUDY OF SYSTEM IMPLICATIONS OF HIGH SPEED FLYWHEELS AS ENERGY STORAGE DEVICES ON SATELLITES, VOLUME 1 Final Report**

H Nghia Nguyen and Francois Mariau Oct 1978 68 p refs  
2 Vol  
(Contract ESA-3261/77/NL-AK)  
(Rept-30/1020-Vol-1, ESA-CR(P)-1168-Vol-1) Avail NTIS  
HC A04/MF A01

The feasibility of integrated energy storage and attitude control systems using high speed flywheels is demonstrated. The impact of magnetic bearing technologies on these flywheel applications is assessed. The flywheel designs for different mission objectives are briefly reviewed to establish the level of technology required. In particular, power and attitude control sub-systems are evaluated to characterize their functional interaction. Proposed wheel arrays are presented and compared to alternative electrochemical systems. These comparisons indicate that in terms of mass, volume, and reliability flywheels for satellite applications are preferable. The concise design synthesis of the integrated energy storage and attitude control system concept is presented as well as the technical indexes. Author (ESA)

**N79-30835#** Engins Matra, Velizy (France) Automatisme Dept

**STUDY OF SYSTEM IMPLICATIONS OF HIGH SPEED FLYWHEELS AS ENERGY STORAGE DEVICES ON SATELLITES, VOLUME 2**

H Nghia Nguyen and Francois Mariau Oct 1978 262 p refs  
2 Vol  
(Contract ESA-3261/77/NL-AK)  
(Rept-30/1020-Vol-2, ESA-CR(P)-1168-Vol-2) Avail NTIS  
HC A12/MF A01

The feasibility of integrated energy storage and attitude control systems using high speed flywheels is demonstrated. The impact of magnetic bearing technologies on these flywheel applications is assessed. The flywheel designs for different mission objectives are briefly reviewed at the level of technology required. In particular, power and attitude control sub-systems are evaluated to characterize their functional interaction. Proposed wheel arrays are presented and compared to alternative electrochemical systems. These comparisons indicate that in terms of mass, volume, and reliability flywheels for satellite applications are preferable. This report exists as two volumes. Volume 1 contains the concise design synthesis of the Integrated Energy Storage and Attitude Control System concept. Volume 2 contains the technical appendices. Author (ESA)

**N79-30836#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen (West Germany) Inst fuer Chemische Antriebe und Verfahrenstechnik

**PHOTOLYTIC DECOMPOSITION OF WATER INTO OXYGEN AND HYDROGEN AS AN ALTERNATIVE ENERGY SOURCE FOR HOUSEHOLDS AND SMALL CONSUMERS**

Wolfgang U Wendekamm Jan 1978 48 p refs In GERMAN, ENGLISH summary. Report will also be announced as translation (ESA-TT-582)  
(DLR-FB-78-17) Avail NTIS HC A03/MF A01, DFVLR, Cologne DM 19.90

The photolytic decomposition of water into oxygen and hydrogen is one of the possible alternatives for the transformation of solar energy into storable secondary energy for practical utilization by households and small consumers. After a survey of the possible cycles of water decomposition, the chemical and physical fundamentals of the photolytic decomposition of water using inorganic catalysts and sensitizers are described. Finally, a total house energy supply system is presented as one illustration of the application possibilities. Author (ESA)

**N79-30837#** Applied Physics Lab, Johns Hopkins Univ, Laurel, Md

**GEOTHERMAL ENERGY MARKET STUDY ON THE ATLANTIC COASTAL PLAIN. A REVIEW OF RECENT ENERGY**

**PRICE PROJECTIONS FOR TRADITIONAL SPACE HEATING FUEL, 1985-2000**

Richard Weissbrod and William Barron Mar 1979 47 p refs  
(Contract EX-76-A-36-1008)  
(PB-294013/8 APL/JHU/GEMS-005, APL/JHU/QM-79-016, MCGER-79/0001) Avail NTIS HC A03/MF A01 CSCL 21D

In order to develop an initial estimate of the potential competitiveness of low-temperature (45 to 100 C) geothermal resources on the Atlantic Coastal Plain, available energy price projections are reviewed and compared. Since low-temperature geothermal energy competes primarily for the space and process heating markets currently held by petroleum, natural gas, and electricity, projected trends in the real prices for these fuels were examined. GRA

**N79-30839#** Federal Trade Commission, Washington, D C Bureau of Economics

**ECONOMIC STRUCTURE AND BEHAVIOR IN THE NATURAL GAS PRODUCTION INDUSTRY**

Joseph P Mulholland Feb 1979 179 p refs  
(PB-294610/1, FTC/BE-79/04) Avail NTIS  
HC A09/MF A01 CSCL 10A

The competitive potential of the natural gas production industry is evaluated. Attention focuses primarily on seller structure within the gas sector, on both a nationwide and regional basis. In a behavioral context charges of monopolistic supply restraint by the major producers are evaluated by examining the ownership pattern of nonproducing leases in the Federal offshore area. Since Federal price regulation has had a pervasive effect on the gas sector's performance up to the present time, the report's objective is not to evaluate the industry's past performance but, rather, to gauge its potential for workable competition in the absence of price regulation in the future. GRA

**N79-30840#** United Nations Industrial Development Organization, Vienna (Austria)

**INTERNATIONAL FORUM ON APPROPRIATE INDUSTRIAL TECHNOLOGY. APPROPRIATE TECHNOLOGY FOR RURAL ENERGY SUPPLY IN DEVELOPING COUNTRIES**

T Turner Oct 1978 269 p refs. Forum held at New Delhi/Anand, 20-30 Nov 1978  
(PB-294602/8) Avail NTIS HC A12/MF A01 CSCL 10A

Trends in the search for appropriate energy technologies are described. Situation of the issues of energy supply for integrated rural development within an institutional and international framework was discussed. Recommendations are given. GRA

**N79-30846#** Argonne National Lab III Div of Environmental Control Technology

**ENVIRONMENTAL CONTROL IMPLICATIONS OF INCREASED COAL UTILIZATION UNDER THE NATIONAL ENERGY PLAN**

Myron Gottlieb (DOE, Washington, D C), C D Livengood and K E Wilzbach 1978 18 p refs. Presented at the 71st Air Pollution Control Assoc Meeting Houston, Tex 25 Jun 1978 (Contract W-31-109-eng-38)  
(ANL/EES-CP-10 Conf-780636-9) Avail NTIS  
HC A02/MF A01

The development, selection, and use of proper environmental controls for the increased utilization of coal is discussed. The complexity of the regulatory and control issues for environmental quality are presented with the impacts they will incur on the coal industry and population. AWH

**N79-30848#** Southern Research Inst, Birmingham Ala  
**STUDY OF ELECTROSTATIC PRECIPITATORS INSTALLED ON OIL-FIRED BURNERS Final Report**

Alan H Dean Jun 1978 185 p refs  
(EPRI Proj 413-1)  
(EPRI-FP-792-Vol-2) Avail NTIS HC A09/MF A01

The use of electrostatic precipitators for collection of effluent from oil-fired boilers in the utility industry is discussed. Basically the information is presented in two sections: literature survey and industry survey. The objectives were to document usage of electrostatic precipitators on oil-fired utility boilers to present

any available design and performance data, to discuss the operating experience and to present procedure employed to remedy problems identified. A detailed report is presented concerning costs of an electrostatic precipitator for a hypothetical 100 MW oil-fired utility plant, costs were based on year 1971 and are updated to 1976 DOE

**N79-30856#** SRI International Corp. Menlo Park, Calif  
**MODELING OF STATIONARY AIR POLLUTION SOURCES IN THE CENTRAL AND WESTERN KERN COUNTY OIL FIELDS. TASK REPORT. VOLUME 2: APPENDICES**  
Patricia B. Simmon Jan 1979 78 p  
(Contract EPA-68-01-4137)  
(PB-294813/1, SRI-5258-7-Vol-2) Avail NTIS  
HC A05/MF A01 CSCL 138

Sulfur dioxide pollution from steam-injection oil recovery and from other sources in Kern County, California, was studied with a mathematical model. This volume consists of tables of data and of a list of modifications made to the CDM program. GRA

**N79-30857#** National Technical Information Service, Springfield, Va

**POLLUTION AND ENVIRONMENTAL ASPECTS OF FUEL CONVERSION. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Mar. 1979**

Audrey S. Hundemann May 1979 278 p. Supersedes NTIS/PS-78/0314, NTIS/PS-77/0212, NTIS/PS-76/0222 and NTIS/PS-75/371

(NTIS/PS-79/0378, NTIS/PS-78/0314, NTIS/PS-77/0212, NTIS/PS-76/0222, NTIS/PS-75/371) Avail NTIS  
HC \$28.00/MF \$28.00 CSCL 07A

Abstracts dealing with environmental impacts related to fossil fuel conversion processes (primarily coal gasification) are presented. A few citations concerning environmental considerations pertaining to future energy growth are included. GRA

**N79-30864#** Radian Corp., Austin, Tex  
**TRACE ELEMENTS OF FLY ASH: EMISSIONS FROM COAL-FIRED STEAM PLANTS EQUIPPED WITH HOT-SIDE AND COLD-SIDE ELECTROSTATIC PRECIPITATORS FOR PARTICULATE CONTROL. Final Report**

Robert M. Mann, Robert A. Magee, Robert V. Collins, Michael R. Fuchs, and Frank G. Mesich Dec 1978 163 p refs  
(Contract EPA-68-01-3702)

(PB-295040/0, RAD-78-216-137-09, EPA-908/4-78-008) Avail NTIS HC A08/MF A01 CSCL 07D

The results of a sampling and chemical analysis study of emissions from two coal-fired steam plants equipped with electrostatic precipitators for particulate control are described. Fly ash collected from the stack using cyclones and cascade impactors was analyzed to define trace element concentration of individual size fractions. Trace element enrichment of ash fractions was compared with an enrichment model to define the dependence of enrichment on particle size. Samples of the feed coal at each station were subjected to density separation to determine the association of each element with mineral (ash) and organic (ash-free) phases of the coal. GRA

**N79-30866#** North Carolina State Univ. at Raleigh Dept. of Chemical Engineering

**POLYMERIC INTERFACES FOR STACK MONITORING. Final Report, Jan 1973 - Jun 1976**

Richard M. Felder and James K. Ferrell Nov 1978 187 p refs

(Grant EPA-R-801578)  
(PB-294997/2, EPA-600/2-78-214) Avail NTIS  
HC A09/MF A01 CSCL 14B

Research has been performed on the use of polymeric interfaces for in situ continuous stack monitoring of gaseous pollutants. Permeabilities of candidate interface materials to SO<sub>2</sub> were measured at temperatures from ambient to 200°C, and the results were used to design interfaces for field tests. A portable field monitoring system was constructed and used to carry out SO<sub>2</sub> monitoring runs in two SO<sub>3</sub> absorption towers

and in oil-fired and coal-fired power plant boiler stacks. The results were in agreement with data obtained by standard wet chemical methods. GRA

**N79-30908#** Sandia Labs., Albuquerque, N. Mex

**STATUS OF THE OFFSHORE TECHNOLOGY PROGRAM**  
Eric W. Reece 1978 9 p refs. Presented at the 4th Symp. on Enhanced Oil and Gas Recovery and Improved Drilling Methods, Tulsa, Okla., 29 Aug 1978

(Contract EY-78-C-04-0789)  
(SAND-78-0665, Conf-780825-11) Avail NTIS  
HC A02/MF A01

The development of instrumentation systems capable of collecting marine and geologic hazards data in frontier regions of the outer continental shelf is described. Elements common to a variety of remote seafloor instrumentation applications such as acoustic telemetry, digital data acquisition, processing, and storage plus command and control techniques were demonstrated. The design of a seafloor earthquake measurement system was completed. DOE

**N79-30923#** Oak Ridge National Lab., Tenn  
**MUTAGENIC COMPONENTS OF ALTERNATE ENERGY SOURCES**

James L. Epler and M. R. Guerin 1978 13 p refs. Presented at 71st Air Pollution Assoc. Meeting, Houston, Tex., 25 Jun 1978

(Contract W-7405-eng-26)  
(CONF-780636-8) Avail NTIS HC A02/MF A01

The use of short term mutagenicity assays to predict the potential biohazard of various crude and complex test materials was examined in a coupled chemical and biological approach. Preliminary chemical characterization and preparation for bioassay, followed by testing in the histidine reversion assay, was emphasized. The mutagenicity tests are intended to act as predictors of profound long range health effects such as mutagenesis and/or carcinogenesis, act as a mechanism to rapidly isolate and identify a hazardous biological agent in a complex mixture, and function as a measure of biological activity correlating base line data with changes in process conditions. Mutagenicity tests can also aid in identifying the specific hazardous compounds involved and in establishing priorities for further definitive testing, testing in whole animals, and more definitive chemical analysis and monitoring. DOE

**N79-31024#** Argonne National Lab. Ill  
**HAZARDS FROM RADIOACTIVE WASTE IN PERSPECTIVE**

Bernard L. Cohen 27 Feb 1979 9 p. Presented at Symp. on Waste Management and Fuel Cycles 1979, Tucson, Ariz., 28 Feb 1979

(Contract W-31-109-eng-38)  
(CONF-790204-9) Avail NTIS HC A02/MF A01

The hazards from wastes from a 1000 MW(e) nuclear power plant to these from wastes from a 1000 MW(e) coal fueled power plant are compared. The latter hazards is much greater than the former. The toxicity and carcinogenicity of the chemicals produced in coal burning is emphasized. Comparisons are also made with other toxic chemicals and with natural radioactivity. DOE

**N79-31067#** Decision Focus, Inc., Palo Alto, Calif  
**RESOURCE-ALLOCATION METHODOLOGY FOR ESTABLISHING RD AND D BUDGETARY PRIORITIES**

D. W. Boyd, D. W. North and S. G. Regulinski Feb 1978 178 p refs

(Contract ET-78-C-05-5474)  
(ORO-5474-T1) Avail NTIS HC A09/MF A01

The R, D and D resource-allocation methodology is designed for use by the Assistant Secretary, Energy Technology in establishing budgetary priorities. It defines a logical process for developing a portfolio of programs consistent with policy goals of the Assistant Secretary, the complexities of the energy marketplace and the departmental resource constraints. The



methodology has two important components a set of analytic procedures and a process for communicating information Both of these aspects are necessary if the methodology is to be successfully implemented Thus, it is the combination of these two aspects that provides the logical decision process that can cope with the complexities of choosing a portfolio of programs  
DOE

**N79-31082#** Department of Energy Washington D C Energy Information Administration  
**EVALUATION OF FUTURE WORLD OIL PRICES**  
K L Kincel, C Kilgore and M Rodekohl 2 Jun 1978 81 p refs  
(DOE/EIA-0102/4) Avail NTIS HC A05/MF A01

An analysis is presented which documents an application of several EIA macroeconomic and energy models to the evaluation of higher world oil prices in the 1980s An assessment of severe price increases is presented and several adjustments that were made to the models in order to assess the higher world oil prices are included  
DOE

**N79-31083#** Department of Energy, Dallas, Tex Energy Information Administration  
**REGIONAL RESIDENTIAL SECTOR ENERGY PRICE FORECASTS FOR 1978: ELECTRICITY, NATURAL GAS, NUMBER 2 FUEL OIL, AND PROPANE**  
P Donvito and H Walton Mar 1979 20 p  
(DOE/EIA-0102/46) Avail NTIS HC A02/MF A01

The prices are intended for use in appliance labeling Average (as opposed to marginal) prices were requested, because they were considered more comprehensible to consumers and, therefore, appropriate for labeling purposes Regional prices were calculated from state data State prices can vary substantially, even within regions Consequently, state price data are also provided The estimates for 1978 were developed by extending price trends from the three prior years for electricity and natural gas, and the previous 12 months for heating oil and propane A discussion of the methods and sources used for each energy source is presented  
DOE

**N79-31085#** Committee on Science and Technology (U S House)  
**NASA AUTHORIZATION, 1980, VOLUME 1, PART 4**  
Washington GPO 1979 760 p refs Hearings on HR 1756 before the Subcomm on Space Sci and Applications of the Comm on Sci and Technol, 96th Congr, 1st Sess, 15, 21-22, 28 Feb, 9, 12 Mar 1979  
(GPO-46-423) Avail Subcomm on Space Sci and Applications

Budget requests for NASA's Office of Space Transportation are justified with emphasis on the supplemental request for space shuttle appropriations Space applications programs related to using space as a relay point, for Earth observation, and to exploit its specific characteristics are discussed as well as the satellite conversion and transmission of energy to Earth Field hearings at Rockwell International and Lockheed are included  
A R H

**N79-31087#** Detroit Diesel Allison, Indianapolis, Ind  
**CONCEPTUAL DESIGN STUDY OF AN IMPROVED GAS TURBINE (IGT) POWERTRAIN** Report, Mar. - Nov. 1978  
R A Johnson Jul 1979 241 p refs Revised  
(Contract DEN3-28)  
(NASA-CR-159604, DDA-EDR-9719, DOE/NASA/0028-79/1) Avail NTIS HC A11/MF A01 CSCL 13F

Design concepts for an improved automotive gas turbine powertrain are discussed Twenty percent fuel economy improvement (over 1976), competitive costs (initial and life cycle), high reliability/life, low emissions, and noise/safety compliance were among the factors considered The powertrain selected consists of a two shaft gas turbine engine with variable geometry aerodynamic components and a single disk rotating regenerator The regenerator disk, gasifier turbine rotor, and several hot section flowpath parts are ceramic The powertrain utilizes a conventional automatic transmission The closest competitor was a single shaft turbine engine matched to a continuously variable transmis-

sion (CVT) Both candidate powertrain systems were found to be similar in many respects, however, the CVT represented a significant increase in development cost, technical risk, and production start-up costs over the conventional automatic transmission Installation of the gas turbine powertrain was investigated for a transverse mounted, front wheel drive vehicle  
K L

**N79-31088#** Ford Motor Co., Dearborn, Mich  
**CONCEPTUAL DESIGN STUDY OF IMPROVED AUTOMOTIVES GAS TURBINE POWERTRAIN** Final Report  
May 1979 215 p refs Prepared in cooperation with AirResearch Mfg Co., Phoenix, Ariz  
(Contracts DEN3-37, EC-77-A-31-1040)  
(NASA-CR-159580, DOE/NASA/0037-79/1) Avail NTIS HC A10/MF A01 CSCL 13F

Twenty-two candidate engine concepts and nineteen transmission concepts Screening of these concepts, predominantly for fuel economy, cost and technical risk, resulted in a recommended powertrain consisting of a single-shaft engine, with a ceramic radial turbine rotor, connected through a differential split-power transmission utilizing a variable stator torque converter and a four speed automatic gearbox Vehicle fuel economy and performance projections, preliminary design analyses and installation studies in a were completed A cost comparison with the conventional spark ignited gasoline engine showed that the turbine engine would be more expensive initially, however, lifetime cost of ownership is in favor of the gas turbine A powertrain research and development plan was constructed to gain information on timing and costs to achieve the required level of technology and demonstrate the engine in a vehicle by the year 1983  
A R H

**N79-31093#** Oak Ridge National Lab., Tenn  
**ECONOMICS OF THE ANFLOW PROCESS FOR MUNICIPAL SEWAGE TREATMENT**  
W L Griffith Mar 1979 88 p refs  
(Contract W-7405-eng-26)  
(ORNL/TM-6574) Avail NTIS HC A05/MF A01

The cost and energy requirements for conventional activated sludge, trickling-filter, and ANFLOW processes were compared to assess the potential of the ANFLOW process for municipal sewage treatment Based on literature sources capital-cost estimates, operating manpower requirements, energy requirements, and combined annual costs were developed for each alternative  
DOE

**N79-31105#** Office of Technology Assessment Washington, D C  
**TECHNOLOGY ASSESSMENT OF CHANGES IN THE FUTURE USE AND CHARACTERISTICS OF THE AUTOMOBILE TRANSPORTATION SYSTEM. SUMMARY AND FINDINGS**  
Feb 1979 48 p refs 2 Vol  
(PB-293645/8, OTA-T-83, LC-79-600030-1) Avail NTIS HC A03/MF A01 CSCL 13F

The assessment deals with changes in the future use and characteristics of the automobile transportation system that are expected in the near term (by 1985) and those that might evolve over a longer period (through 2000 and beyond) The scope of the assessment is broad and includes not only automobiles but also highways, fuel supply and distribution, automotive repair and service, insurance, traffic management, and law enforcement in short, all of the industries and services that contribute to use of the automobile as a mode of personal transportation The report analyzes the restraints of energy supply, environmental impacts, highway safety, and consumer cost on the further development of the automobile transportation system It discusses Government initiatives that may be necessary to assure such further development  
GRA

**N79-31106#** Office of Technology Assessment Washington, D C  
**TECHNOLOGY ASSESSMENT OF CHANGES IN THE FUTURE USE AND CHARACTERISTICS OF THE AUTOMOBILE TRANSPORTATION SYSTEM, VOLUME 2**

Feb 1979 385 p refs 2 Vol  
(PB-293646/6, OTA-T-84, LC-79-600030-2) Avail NTIS  
HC A17/MF A01 CSCL 13F

The report consists of three parts. The first part contains background information, a description of the elements of the automobile transportation system. Base Case projections, and delineation of the policy alternatives that were considered. A baseline of present and future automobile system characteristics that serve as the frame of reference for policy analysis is provided. The second part contains analyses of policy options in each of the five issue areas: energy, environment, safety, mobility, and cost and capital. A discussion of issues, a summary of present policy, a statement of policy options and analysis of effects and impacts are included. The third part is a survey of expected technological developments in the near term (through 1985) and in the far term (to 2000 and beyond). A summary of major findings is also included. GRA

**N79-31107#** Minibus Forest, Inc., Montreal (Quebec)  
**MODIFICATION AND EVALUATION OF A SMALL STATION  
WAGON DESIGNED FOR TRANSPORTATION OF THE  
HANDICAPPED Final Report**

Jacques Forest and C A Versailles Jun 1978 40 p Transl  
into ENGLISH of Can Rept on Elderly and Handicapped  
Modification Tests Sponsored by DOT and Centre de Rech et  
de Develop Transports Can  
(Proj 6281)

(PB-295106/9, UMTA-MA-06-0025-79-12, TP-1777) Avail  
NTIS HC A03/MF A01 CSCL 13F

The project was designed to modify and evaluate a small stationwagon to be used to transport handicapped people in a door-to-door service. The project made it possible to determine specific data in terms of future modifications. The report concludes that (1) the project shows that a small modified stationwagon can be used to transport handicapped people and provide both a useful and viable service, (2) the prototype evaluated has the required size, capacity, comfort, and versatility, and (3) the cost of modification, the weight and gas consumption could be substantially reduced if these vehicles were modified en masse, because that would justify using a fiberglass body rather than a steel one. GRA

**N79-31110#** Transportation Systems Center, Cambridge, Mass  
**DIESEL BUS PERFORMANCE SIMULATION PROGRAM  
Final Report, Mar 1977 - Apr. 1979**

Glenn Larson and Harry Zuckerberg Apr 1979 206 p refs  
(PB-295524/3, DOT TSC-UMTA-79-16,  
UMTA-MA-06-0044-79-1) Avail NTIS HC A10/MF A01  
CSCL 13F

A diesel bus performance computer simulation program was developed. This program provides information on acceleration, velocity, horsepower, distance traveled, and fuel consumption as a function of time from the originating station. The program was written for diesel engine operation although heat engines other than diesel may be substituted. Fuel economy calculations, using the program, agree well with available measurements on urban buses and may be considered as representative of a baseline urban bus. Component submodels and vehicle coefficients used in the program were carefully structured to represent current urban buses. A general description of the simulation program and the type of input data it required along with the results obtained by simulating a typical transit bus are included. GRA

**N79-31163#** National Aeronautics and Space Administration  
Washington D C

**SUPERSONIC TRANSPORT VIS-A-VIS ENERGY SAVINGS**

G Cormery Sep 1979 27 p Transl into ENGLISH from  
Aeron Astronaut (Paris), vol 69, no 2, 1978 p 3-14 Original  
language document was announced as A78-35893 Transl by  
Kanner (Leo) Associates Redwood City, Calif  
(Contract NASw-3199)

(NASA-TM-75464) Avail NTIS HC A03/MF A01 CSCL  
01C

The energy and economic saving modifications in super-  
sonic transportation are studied. Modifications in the propulsion

systems and in the aerodynamic configurations of the Concorde  
aircraft to reduce noise generation and increase fuel efficiency  
are discussed. The conversion of supersonic aircraft from fuel  
oils to synthetic fuels is examined. A W H

**N79-31208#** Pratt and Whitney Aircraft, East Hartford, Conn  
Commercial Products Div

**JT9D-70/59 IMPROVED HIGH PRESSURE TURBINE  
ACTIVE CLEARANCE CONTROL SYSTEM**

W O Gaffin 8 Jun 1979 66 p ref

(Contract NAS8-20630)

(NASA-CR-159661, PWA-5515-87C)

Avail NTIS

HC A04/MF A01 CSCL 21E

The JT9D-70/59 high pressure turbine active clearance  
control system was modified to provide reduction of blade tip  
clearance when the system is activated during cruise operation.  
The modification increased the flow capacity and air impinge-  
ment effectiveness of the cooling air manifold to augment turbine  
case shrinkage capability, and increased responsiveness of the  
airseal clearance to case shrinkage. The simulated altitude engine  
testing indicated a significant improvement in specific fuel  
consumption with the modified system. A 1000 cycle engine  
endurance test showed no unusual wear or performance  
deterioration effects on the engine or the clearance control system.  
Rig tests indicated that the air impingement and seal support  
configurations used in the engine tests are near optimum. K L

**N79-31251#** PRC Energy Analysis Co., McLean, Va  
**SATELLITE POWER SYSTEM (SPS) RESOURCE REQUIRE-  
MENTS (CRITICAL MATERIALS, ENERGY, AND LAND)**

Allan D Kotin (Kotin (Allan D) Economic Consultants, Los Angeles,  
Calif) Oct 1978 128 p refs Sponsored in cooperation with  
NASA

(Contract EG-77-C-01-4024)

(NASA-CR-162310, SE-4024-T1)

Avail NTIS

HC A07/MF A01 CSCL 10A

The resource impacts of the proposed satellite power system  
(SPS) were reviewed. Three classes of resource impacts were  
considered separately: critical materials, energy and land use.  
The analysis focused on the requirements associated with the  
annual development of two five-gigawatt satellites and the  
associated receiving facilities. DOE

**N79-31269#** Royal Netherlands Aircraft Factories Fokker,  
Schiphol-Oost

**EXPERIENCES RELATED TO GEOS THERMAL CONTROL**

N J vandeBrak In ESA Spacecraft Thermal and Environ  
Control Systems Oct 1978 p 19-25 refs

Avail NTIS HC A99/MF A01

The thermal control subsystem of the European scientific  
satellite GEOS is described. Experience obtained during design,  
development, and hardware assembly is reviewed. Special  
attention is paid to electrical conductivity and grounding of thermal  
control materials. Further specific problem areas related to  
appendages, the apogee boost motor, and the reaction control  
equipment are examined. Author (ESA)

**N79-31272#** ISRO Satellite Centre, Peenya, Bangalore (India)  
**OBSERVATIONS MADE DURING THE DEVELOPMENT OF  
A THERMAL CONTROL SYSTEM FOR A NEAR EARTH  
ORBITING SATELLITE**

H N Murthy, D R Bhandari, and V Prasad In ESA Spacecraft  
Thermal and Environ Control Systems Oct 1978 p 47-51  
refs

Avail NTIS HC A99/MF A01

The experience gained during the development of a passive  
thermal control system for the near earth orbiting spacecraft  
'Aryabhata' shows that the system cost could be brought down  
by minimizing the fabrication complexities and the thermal balance

tests Analysis carried out show that the reduced conduction exchange between top and bottom shells of the spacecraft due to the change in fabrication procedures would not affect the temperature distribution appreciably The results of thermal balance test conducted on a 0.4 size scale model yield satisfactory results The inflight temperature data received at the ground station shows good agreement with the predicted temperatures  
Author (ESA)

**N79-31274#** Stuttgart Univ (West Germany) Inst fuer Kernenergetik und Energiesysteme  
**HEAT PIPE TECHNOLOGY FOR SPACECRAFT THERMAL CONTROL**  
M Groll /in ESA Spacecraft Thermal and Environ Control Systems Oct 1978 p 61-70 refs

Avail NTIS HC A99/MF A01

Heat pipe design concepts, materials and temperature ranges of operation are surveyed Characteristics of capillary structures and of heat pipe performance are discussed Variable conductance and thermal diode techniques are discussed and their performance characteristics are presented The state-of-the-art of heat pipe technology for spacecraft temperature control is reviewed and examples of satellite applications are presented In addition the spin-off of this space technology with respect to terrestrial applications is discussed and respective examples are presented  
Author (ESA)

**N79-31275#** Dornier-Werke G m b H, Friedrichshafen (West Germany)  
**DEVELOPMENT OF A HEAT PIPE COOLED 200 WATT TWT WITH IMPROVED EFFICIENCY**  
H Kreeb and P Pawlowski /in ESA Spacecraft Thermal and Environ Control Systems Oct 1978 p 71-72

Avail NTIS HC A99/MF A01

The self-radiating collector of a 200 W 12 GHz TWT is replaced by a heat pipe cooling system The outer diameter of the collector, including the heat pipe cooling system is limited to 40 mm small enough for focusing of the electron beam by magnetic rings The TWT with a magnetically focused collector (3 stages) will improve the overall efficiency to about 44% The other parts of the TWT will be cooled by a separate heat pipe system including a gas-controlled heat pipe radiator A test of the whole system is planned for one of the first missions  
Author (ESA)

**N79-31276#** Erno Raumfahrttechnik G m b H, Bremen (West Germany)  
**A HEAT PIPE RADIATOR FOR SHUNT ELECTRONICS. DEVELOPMENT AND TEST RESULTS**  
R Schlitt /in ESA Spacecraft Thermal and Environ Control Systems Oct 1978 p 73-83 refs Sponsored by Bundesmin fuer Forsch und Technol

Avail NTIS HC A99/MF A01

The design fabrication, and test of a 350 mm x 1600 mm heat pipe radiator to cool large dissipation shunt electronics are described A configuration with six parallel heat pipes held between layers of a honeycomb sandwich was selected using ammonia as the working fluid Special attention was given to the interface with the power transistor Tests were carried out in a liquid nitrogen shrouded vacuum chamber to simulate deep space environment Test results correlate very well with calculated temperatures  
Author (ESA)

**N79-31278#** Societe Nationale Industrielle Aerospatiale Cannes (France)  
**HEAT PIPES IN THE THERMAL CONTROL OF COMMUNICATION SATELLITES OF THE FORTHCOMING GENERATION (H-SAT)**  
B Moschetti /in ESA Spacecraft Thermal and Environ Control Systems Oct 1978 p 91-97 refs

Avail NTIS HC A99/MF A01

Performance of a telecommunications panel with variable conductance heat pipe (VCHP) regulation and of an experimental radiator module with extruded constant conductance heat pipe (CCHP) regulation are described The VCHP regulated panel already presented at the International Heat Pipe Conference in 1976 successfully passed all thermal tests scheduled until September 1976 the results of which are given In December 1977, the panel was once more tested in thermal vacuum and the original thermal performance data recorded 14 months earlier was verified This prototype is currently undergoing the endurance qualification test scheduled for a period exceeding 7 years The CCHP equipped radiator module involves a special mounting technique which combines a carrier honeycomb sandwich structure and two crossed networks of heat pipes The radiator has also passed thermal vacuum tests with quite satisfactory results as to the performance  
Author (ESA)

**N79-31350#** Celanese Research Co Summit NJ  
**ULTRAFINE POLYBENZIMIDAZOLE (PBI) FIBERS Final Report, Jun 1976 - Jun 1979**  
E C Chenevey Jun 1979 119 p refs  
(Contract NAS3-20040)

(NASA-CR-159644) Avail NTIS HC A06/MF A01 CSCL 11D  
Mats were made from ultrafine polybenzimidazole (PBI) fibers to provide an alternate to the use of asbestos as separators in fuel cells and alkaline batteries To minimize distortion during mat drying, a process to provide a dry fibrid was developed Two fibrid types were developed one coarse making mats for battery separators, the other fine making low permeability matrices for fuel cells Eventually it was demonstrated that suitable mat fabrication techniques yielded fuel cell separators from the coarser alkaline battery fibrids The stability of PBI mats to 45% KOH at 123 C can be increased by heat treatment at high temperatures Weight loss data to 1000 hours exposure show the alkali resistance of the mats to be superior to that of asbestos  
Author

**N79-31363#** Oak Ridge National Lab, Tenn  
**ENHANCED OIL RECOVERY CHEMICALS FROM RENEWABLE WOOD RESOURCES**  
W N Grune A L Compere, W L Griffith, and J M Crenshaw Apr 1979 69 p refs  
(Contract W-7405-eng-26)  
(ORNL-5525) Avail NTIS HC A04/MF A01

Processes which produce useful materials from pulp and paper wastewater streams are surveyed Emphasis is placed on chemical recovery processes particularly production of micellar flooding chemicals to be used in advanced petroleum recovery techniques It is indicated that production of industrial chemicals from a renewable continuously harvested resource (wood pulp wastewater streams) may be a viable method to decrease U S dependence on foreign oil producers, to decrease cost of advanced petroleum recovery techniques through the synthesis of low cost chemicals, and to decrease accumulation of pollutable industrial wastes  
J M S

**N79-31364#** Brookhaven National Lab, Upton, N Y  
**FeTi METHANATION CATALYST**  
James R Lynch Len D Spaulding and Richard S Sapienza Jun 1978 12 p refs Presented at Am Chem Soc Meeting Miami Fla, 10-15 Sep 1978  
(Contract EY-76-C-02-0016)  
(BNL-24477, Conf-780902-1) Avail NTIS HC A02/MF A01

The intermetallic compound FeTi was found to catalyze the reduction of CO and CO<sub>2</sub> to methane by hydrogen The CO reduction yielded traces of ethane as did CO<sub>2</sub>, in addition, CO<sub>2</sub> reduction yielded small amounts of methanol The appearance of CH<sub>4</sub> was linear with time for both CO and CO<sub>2</sub> and the rate of CO<sub>2</sub> reduction was faster than that observed for CO The product distribution and rate data lend support to and are discussed in terms of the proposed oxide theory for Fischer-Tropsch and related synthesis  
DOE

**N79-31383#** Sandia Labs, Livermore Calif  
**FORMATION OF PROTECTIVE LAYERS ON ALLOYS DEVELOPED FOR USE IN COAL GASIFICATION ENVIRONMENTS Final Report**

R W Bradshaw, R E Stoltz, and D R Adolphson 30 Sep 1978 100 p refs

(Contract EY-76-C-04-0789)

(SAND-78-8277) Avail NTIS HC A05/MF A01

Improvement in high temperature compatibility of iron and nickel based alloys in coal gasification environments was investigated. The addition of a few weight percent titanium to 310 stainless steel and Ni-30Cr was very effective in both isothermal and cyclic high temperature atmospheres which simulated the corrosion potential existing in the 1800 F high Btu coal gasification process. Alloy fabrication practices were unaffected and standard welding processes did not alter mechanical behavior or compatibility. Further work on 310 revealed that the as-received mechanical properties were unaffected by the Ti additions; that the normal levels of impurities and minimum specification level of chromium did not alter the beneficial effects of Ti, and that the mechanism by which Ti improves compatibility is linked to microstructural or chemical changes in the surface CR203 coating. DOE

**N79-31386#** International Nickel Co., Inc., Suffern, N Y Inco Research and Development Center

**EVALUATION OF HIGH CHROMIUM OVERLAYS TO PROTECT LESS ALLOYED SUBSTRATES FROM CORROSION IN A COAL GASIFICATION ATMOSPHERE Quarterly Report, 1 Dec 1977 - 28 Feb 1978**

Edward P Sadowski 1978 31 p

(Contract EF-77-C-01-2621)

(FE-2621-2) Avail NTIS HC A03/MF A01

The development and evaluation of weld deposited overlays to provide resistance to corrosion in coal gasification atmospheres is reported. Weld deposition techniques and procedures for three weld processes are described. The weld processes are gas tungsten arc with hot wire, gas metal arc, and submerged arc. Single and double overlays were tested and evaluated. The tests consisted of hardness surveys, bend and tensile tests, bulk chemical analysis of the overlay and microprobe analysis for the distribution of the major alloying elements from the outside edge of the overlay through the thickness of the base plate. AWH

**N79-31404#** Committee on Government Operations (U S House)

**BIOMASS CONVERSION**

Washington GPO 1978 163 p refs. Hearing before a Subcomm of the Comm on Government Operations, 95th Congr, 2d Sess 14 Apr 1978

(GPO-32-317) Avail Comm on Government Operations

Testimony was given and arguments were heard on the economics and the technical viability of producing alcohol fuels and chemical feedstocks from agricultural products and wastes and urban organic wastes. MMM

**N79-31405#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

**COMPARISON OF THE PROPERTIES OF SOME SYNTHETIC CRUDES WITH PETROLEUM CRUDES**

Albert C Antoine Jul 1979 31 p refs

(NASA-TM-79220, E-115) Avail NTIS HC A03/MF A01 CSDL 21D

Physical properties and chemical compositions of six synthetic crudes were determined. The results were compared to those of typical petroleum crudes with the interest being the feasibility of making jet fuels from oil shale and coal syncrudes. The specific gravity, viscosity, and pour point were measured, showing that these crudes would be described as heavier rather than lighter crudes. The boiling range distribution of the crudes was determined by distillation and by gas chromatography. In addition, gel permeation chromatograms were obtained giving a unique molecular weight distribution profile for each crude. Analyses

for carbon, hydrogen, nitrogen and sulfur concentrations were performed, as well as for hydrocarbon group type and trace element concentrations. It was found that the range in concentration of vanadium, an element whose presence in turbine fuels is of major concern, was lower than that of petroleum crudes. Sodium and potassium, other elements of concern, were present in comparatively high concentrations. Author

**N79-31406#** National Technical Information Service, Springfield Va

**HYDROGEN PRODUCTION, VOLUME 1 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - 1977**

Diane M Cavagnaro Jun 1979 233 p

(NTIS/PS-79/0540/9) Avail NTIS HC \$28.00/MF \$28.00 CSDL 21D

This bibliography contains citations on the manufacturing of hydrogen by electrolysis, coal gasification and other techniques. They cover both experimental research and production on the industrial scale. Although most of the citations are on production methods, economic studies are also included. (This updated bibliography contains 227 abstracts, none of which are new entries to the previous edition.) GRA

**N79-31407#** National Technical Information Service, Springfield Va

**HYDROGEN PRODUCTION, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1978 - May 1979**

Diane M Cavagnaro Jun 1979 150 p. Supersedes NTIS/PS-75/379, NTIS/PS-78/0514, NTIS/PS-77/0492, NTIS/PS-76/0459

(NTIS/PS-79/0541/7, NTIS/PS-75/379, NTIS/PS-78/0514, NTIS/PS-77/0492, NTIS/PS-76/0459) Avail NTIS HC \$28.00/MF \$28.00 CSDL 21D

The cited reports include studies on the manufacturing of hydrogen by electrolysis, coal gasification and other techniques. They cover both experimental research and production on the industrial scale. Although most of the reports are on production methods, economic studies are also included. The updated bibliography contains 144 abstracts, 49 of which are new entries to the previous edition. GRA

**N79-31410#** Institute of Gas Technology, Chicago, Ill

**RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS (RISER CRACKING OF COAL) Quarterly Report, 1 Jul. - 30 Sep 1978**

D A Duncan, Justin L Beeson and R Donald Oberle Dec 1978 34 p refs

(Contract EX-76-C-01-2307)

(FE-2307-42, QR-2) Avail NTIS HC A03/MF A01

Methods for handling caking coals were explored including the use of dry diluents, extractive solvents, and additives. Both silica sand and devolatilized char were successfully used as dry diluents, but processing was inefficient. Slurrying with a solvent carrier comprised of 20% weight naphthalene, 40% by weight toluene, and 40% by weight phenol is in the evaluation stage, as is the use of additives which are used at the level of 10% by weight additive with 90% by weight coal. One of the most promising systems is coal treated in water with calcium hydroxide with subsequent evaporation of the water to obtain dry solids for feeding. A low pressure simulator of a PD combustor section was built and operated; there does not appear to be any critical relationship between the mainstream velocity and the entering oxygen velocity, allowing considerable latitude in sizing the air/oxygen injection needle. For temperature changes of 300 F, the use of ceramic shields does not appear to be necessary. DOE

**N79-31411#** SRI International Corp., Menlo Park, Calif

**HOMOGENEOUS CATALYTIC HYDROCRACKING PROCESSES FOR CONVERSION OF COAL TO LIQUID FUELS: BASIC AND EXPLORATORY RESEARCH Quarterly Report, 16 Sep - 15 Dec 1978**

12 Mar 1979 33 p refs

(Contract EX-76-C-01-2202)

(FE-2202-39) Avail NTIS HC A03/MF A01

The role of base in both coal and lignite liquefaction in the CO-H<sub>2</sub>O system was explored as well as the catalysis of coal conversion in tetralin by KOH, and the effects of LiAlH<sub>4</sub> pretreatment of coal on its subsequent upgradability. Results suggest that, although KOH is important for obtaining high conversion yields from bituminous coal in CO-H<sub>2</sub>O, its importance is largely indirect, serving to leach transition metals from the autoclave. Lignite conversion is little affected by the presence or absence of KOH in the system. The addition of KOH and H<sub>2</sub>O to tetralin had no effect on bituminous coal conversion; the action of tetralin was not catalyzed. Pretreatment of a bituminous coal with LiAlH<sub>4</sub> to reduce any quinones present had a small but measurably favorable effect on its solubility compared with that of untreated coal. This difference remained even after heating under vacuum, but disappeared upon heating in H<sub>2</sub> or tetralin. DOE

**N79-31413#** Midwest Research Inst., Golden, Colo  
**PROCESS DESIGNS AND COST ESTIMATES FOR A MEDIUM BTU GASIFICATION PLANT USING A WOOD FEEDSTOCK**

Raymond E. Desrosiers Feb 1979 61 p refs  
 (Contract EG-77-C-01-4042)  
 (SERI/TR-33-151) Avail NTIS HC A04/MF A01

A gasification plant to effect the conversion of wood to medium Btu gas described. The cost of the processing steps common to all gasification schemes and specific research areas are examined. Capital investment statements for three plant sizes are included along with manufacturing costs for each of these at three feedstock prices. The design incorporates a front end handling system, package cryogenic oxygen plant, the gasifier, a gas cleaning train consisting of a spray scrubber, ionizing wet scrubber, and condenser, and a wastewater treatment facility including a cooling tower and a package activated sludge unit. Cost figures for package units were obtained from suppliers and used for the oxygen and wastewater treatment plants. The gasifier is fed with wood chips at 20% moisture (wet basis). For each pound of wood, 0.32 lb of oxygen are required, and 1.11 lb of gas are produced. DOE

**N79-31414#** Braun (C. F.) and Co., Alhambra, Calif  
**COMBINED SHIFT-METHANATION PROCESSES** Final Report

N. G. Kartamus Sep 1978 32 p  
 (Contract EX-76-C-01-2240)  
 (FE-2240-97) Avail NTIS HC A03/MF A01

The potential advantage of combining shift and methanation reactions is the reduction of two gas processing operations employing separate catalysts and reactors into a single operation with only one catalyst. Multiple reactors are required for both the combined shift methanation and separate shift methanation processes. The basis for economic comparison is the lowest total of capital cost plus four years of operating costs. The results show that the separate shift and methanation process is clearly superior economically to the three combined shift and methanation processes originally proposed by the licensors. Because of the high cost of energy, the relative economics of these processes is strongly influenced by energy recovery. The major factor in favor of the separate shift and methanation processes is that it recovers more useful energy than the combined shift methanation processes. The relative rankings are shown. DOE

**N79-31415#** Utah Univ., Salt Lake City Dept. of Mining and Fuels Engineering  
**APPLIED RESEARCH AND EVALUATION OF PROCESS CONCEPTS FOR LIQUEFACTION AND GASIFICATION OF WESTERN COALS** Quarterly Progress Report, Apr - Jun 1978

W. H. Wiser Jul 1978 49 p  
 (Contract EX-76-C-01-2006)  
 (FE-2006-12) Avail NTIS HC A03/MF A01

Sixteen research projects in the gasification or liquefaction of coal, catalysis, or related research are reviewed. Fundamental principles involved and the properties of coal and coal conversion products are discussed. DOE

**N79-31416#** Bechtel Corp., San Francisco, Calif  
**ANALYSIS OF COAL HYDROGASIFICATION PROCESSES** Final Report

M. Epstein, T. P. Chen and M. A. Ghaly Aug 1978 166 p refs  
 (Contract EF-77-A-01-2565)  
 (FE-2565-14) Avail NTIS HC A08/MF A01

The operability potential and scaleup feasibility of coal hydrogasification processes were investigated. The entrained downflow reactor systems operate at temperatures up to 2,000 F and pressures up to 3,000 psi. Reactor product is primarily methane. Bituminous, subbituminous and lignite coal hydrogasification and hydrolysis data for each process were collected and analyzed. Semiempirical correlations for predicting overall carbon conversion efficiency and carbon selectivity to gaseous products were fitted to the data. A conceptual design of a full-scale hydrogasification reactor was generated on the basis of the subbituminous coal data gathered in the various reactors, together with the predictive reactor performance models fitted to the data. DOE

**N79-31417#** Braun (C. F.) and Co., Alhambra, Calif  
**CONSIDERATIONS IN SIZING COAL GASIFICATION PLANTS** Final Report

R. E. Musgrove and D. L. Maifield 1978 68 p refs  
 (Contract EX-76-C-01-2240)  
 (FE-2240-40) Avail NTIS HC A04/MF A01

The economy of scale favors the largest practical size plant. The size constraints of practicality for coal gasification at this time are principally technological, through under some circumstances coal availability, market demand, labor conditions, capital availability, and particularly regulatory policy may have some influence on the size of a plant at a particular location. The 250 billion Btu per day size plant seems to meet all of the constraints fairly well, though the specific size is not mandatory. Many plants of that size could be built in the areas we studied. The increased cost of gas produced from plants smaller than 250 billion Btu per day practically dictates the alternative of transporting coal and water over reasonable distances to a 250 billion Btu per day or larger size plant. Building separate smaller plants at the site of the coal deposits should only be considered under unusual circumstances of local demand or terrain which would make transportation of resources significantly less attractive. DOE

**N79-31418#** Pittsburgh Univ., Pa. Dept. of Chemical and Petroleum Engineering

**ADDITION OF DEVOLATILIZATION EQUATIONS TO SYNTHANE COMPUTERIZED MATHEMATICAL MODEL** Quarterly Report, 15 Sep - 15 Dec 1978

J. T. Cobb, Jr. Jan 1979 10 p refs  
 (Contract EW-78-S-22-0277)  
 (COO-0277-1) Avail NTIS HC A02/MF A01

Six approaches to devolatilization modeling were reviewed. Two were further evaluated: the Vand-type model of Anthony and Howard and the diffusion model of Russel et al. The first of these treats particles under kinetic control only. The second includes some mass transfer control along with kinetic control. Behavior of particles in the synthane process appears to be in the transition region between kinetic and mass transfer control. DOE

**N79-31419#** Oklahoma State Univ., Stillwater School of Chemical Engineering

**DEVELOPMENT OF A PROCESS FOR PRODUCING AN ASHLESS, LOW-SULFUR FUEL FROM COAL. VOLUME 4. PRODUCT STUDIES. PART 10. COAL LIQUIDS CATALYST WORK PERFORMED AT OKLAHOMA STATE UNIVERSITY. SOLVENT REFINED COAL (SRC) PROCESS** Final Interim Report, 17 Jun 1970 - 16 Jun 1975

Billy L. Crynes Jan 1979 79 p refs. Prepared in cooperation with Pittsburg and Midway Coal Mining Co., Shawnee Mission, Kans.  
 (Contract EX-76-C-01-0496)  
 (FE-0496-T10-Vol-4-Pt-10, FIR-19)  
 Res/Develop-53-Vol-4-Pt-10) Avail NTIS HC A05/MF A01

The effects of catalyst support pore properties on sulfur and nitrogen removal from certain coal liquids were assessed. The research was divided into three broad areas: (1) equipment and analytical operability, (2) catalyst assessment over variables of space time, temperature, and pressure, and (3) 200 hour catalyst activity tests at fixed conditions. DOE

**N79-31421# Brookhaven National Lab., Upton, N Y  
FUSION REACTORS FOR SYNTHETIC FUELS**

J R Powell 1979 5 p Presented at the ANS Ann Meeting, Atlanta, 3-6 Jun 1979  
(Contract EY-76-C-02-0016)  
(BNL-25634 Conf-790602-39) Avail NTIS  
HC A02/MF A01

Some of the types of processes now being considered for synthetic fuels production from fusion energy, together with an example of each type are listed. The process efficiency is defined as the chemical energy in the generated hydrogen (at the higher heating value (HHV)) divided by the total fusion energy release, including alpha particles and secondary neutron reactions in the blanket. Except where specifically noted, both high and low temperature blanket heats are counted as part of total fusion energy release. DOE

**N79-31422# Midwest Research Inst., Golden, Colo  
PHOTOBIOLOGICAL PRODUCTION OF HYDROGEN A  
SOLAR ENERGY CONVERSION OPTION**

P Weaver, S Lien, and M Seibert Jan 1979 109 p refs  
(Contract EG-77-C-01-4042)  
(SERI/TR-33-122) Avail NTIS HC A06/MF A01

The history of photobiological hydrogen production from its discovery in relatively pure cultures during the early 1930s to the present is reviewed with emphasis on hydrogen production by phototrophic organisms (and their components) which occurs at the expense of light energy and electron-donating substrates. Among the topics included is an overview of hydrogen metabolism in photosynthetic bacteria, eucaryotic algae, and cyanobacteria (blue-green algae). The primary enzyme systems, including hydrogenase and nitrogenase, are discussed along with the manner in which they are coupled to electron transport and the primary photochemistry of photosynthesis. A number of in vivo and in vitro photobiological hydrogen evolving schemes including photosynthetic bacterial, green algal, cyanobacterial, two-stage, and cell-free systems are examined. Specific technical problem areas that currently limit the yield and duration of many of the systems and research that might lead to progress in these specific areas are discussed. DOE

**N79-31423# Department of Energy, Bartlesville, Okla Energy  
Technology Center**

**ETHANOL/GASOLINE BLENDS AS AUTOMOTIVE FUEL**  
J R Allsup and D B Eccleston May 1979 17 p refs  
(BETC/R1-79/2) Avail NTIS HC A02/MF A01

Vehicle tests were conducted to determine the influence of ethanol in a 10% ethanol/90% gasoline fuel mixture on fuel economy, regulated and unregulated exhaust emissions, exhaust hydrocarbon distribution, and road octane quality. Volumetric fuel economy was shown to be slightly decreased while energy economy was slightly increased using the ethanol/gasoline blend compared to gasoline. When compared to the base gasoline, the use of the ethanol/gasoline blend caused no deleterious effects upon regulated emissions at ambient temperatures from 20 to 75 F, at 100 F ambient there were minor increases in emissions using the ethanol/gasoline blend. The ethanol/gasoline blend generally had either no effect on or reduced all unburned hydrocarbon components except at the 100 F test conditions compared to gasoline. Road octane quality was shown to be increased by the use of the ethanol/gasoline blend compared to gasoline. DOE

**N79-31432# Aerospace Corp., El Segundo, Calif  
UTILIZATION OF USED OIL Final Report**  
G J Mascetti and H M White Aug 1978 396 p  
(Contract EY-76-C-1101-003)  
(ATR-78(7384)1) Avail NTIS HC A17/MF A01

The potential impact of re-refining used automotive and industrial lubricating oils on the national petroleum consumption is assessed. The technical base for this assessment is derived from a comprehensive review of the processes utilized in re-refining used oil and those processes used to produce lube oil from crude. Existing and recently proposed processes are considered. An extensive review of processes described in the patent literature is provided. Re-refining processes are surveyed and evaluated. Process descriptions are provided, hardware is identified, and process energy and economic requirements are calculated. Factors affecting the profitability of a re-refining operation are discussed. Economic projections of the demand for lube oil and the ability to satisfy this demand from crude oil are made and the value of lube oil as a vital resource and the need for conservation are addressed. DOE

**N79-31433# National Technical Information Service, Springfield, Va**

**SYNTHETIC FUELS FROM MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL WASTES CITATIONS FROM THE NTIS DATA BASE Report, 1964 - Apr 1979**

Audrey S Hundemann Jun 1979 172 p Supersedes NTIS/PS-78/0499, NTIS/PS-77/0112, NTIS/PS-76/0795, NTIS/PS-75/655  
(NTIS/PS-79/0545/8, NTIS/PS-78/0499 NTIS/PS-77/0112, NTIS/PS-76/0795, NTIS/PS-75/655) Avail NTIS  
HC \$28 00/MF \$28 00 CSCL 21D

This bibliography contains 164 citations on the production of gaseous and liquid synthetic fuels from solid wastes. Waste products used in the syntheses including manure, sewage, paper, and wood are included. Methane is the primary fuel produced, however, the production of oils, methanol, and ethanol is also discussed. GRA

**N79-31434# National Technical Information Service, Springfield, Va**

**SYNTHETIC FUELS FROM MUNICIPAL, INDUSTRIAL AND AGRICULTURAL WASTES, VOLUME 1. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Report, 1975 - 1977**

Audrey S Hundemann Jun 1979 289 p  
(NTIS/PS-79/0546/6) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

This bibliography cites worldwide literature on the production of fuels from waste materials such as animal manure, wood chips, sewage sludge, urban garbage, agricultural wastes, and old automobile tires. This updated bibliography contains 283 abstracts, none of which is new to the previous edition. GRA

**N79-31435# National Technical Information Service, Springfield, Va**

**SYNTHETIC FUELS FROM MUNICIPAL, INDUSTRIAL AND AGRICULTURAL WASTES, VOLUME 2. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1978 - Mar 1979**

Audrey S Hundemann Jun 1979 63 p Supersedes NTIS/PS-78/0500 and NTIS/PS-77/0113  
(NTIS/PS-79/0547/4, NTIS/PS-78/0500, NTIS/PS-77/0113) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

This bibliography cites worldwide literature on the production of fuels from waste materials, such as animal manure, wood chips, sewage sludge, urban garbage, agricultural wastes, and old automobile tires. (This updated bibliography contains 57 abstracts, all of which are new entries to the previous edition.) GRA

**N79-31436# Minnesota Univ., Minneapolis School of Public Health**

**HOSPITAL VENTILATION STANDARDS AND ENERGY CONSERVATION A SUMMARY OF THE LITERATURE WITH CONCLUSIONS AND RECOMMENDATIONS Final Report, FY 1978**

Roger L DeRoos, Robert S Banks, David Rainer, Jonna L Anderson, and George S Michaelson Sep 1978 308 p refs  
Prepared for California Univ. Lawrence Berkeley Lab

(Contract W-7405-eng-48)

(LBL-8316, EEB-Hosp-78-3) Avail NTIS HC A14/MF A01

The basis for current hospital heating, ventilation, and air conditioning standards were examined to determine if the standards could be relaxed based on criteria that does not compromise the health, safety and comfort of patients and staff and that has acceptance of the health community. Principles are presented which favor a reduction of dependence on outdoor air for control of the unique hazards in hospitals. Control of these hazards could be managed by point source control of microenvironments. Then ventilation air criteria would become analogous to that for other building spaces. However, it must be recognized that implementation of the presented principles requires concurrent changes in hospital operating procedures, some of which require additional research. R E S

**N79-31438#** Bechtel National, Inc., San Francisco, Calif  
**CONCEPTUAL DESIGN AND COST STUDY FOR A DUAL-PURPOSE NUCLEAR-ELECTRIC REVERSE OSMOSIS SEAWATER CONVERSION PLANT**

Apr 1979 130 p refs

(Contract W-7405-eng-26)

(ORNL/TM-6821) Avail NTIS HC A07/MF A01

A conceptual design and cost estimate for a 25 million gallon per day seawater reverse osmosis desalting plant operating at both Caribbean and Persian Gulf sites were developed. The plant would operate in conjunction with a 1000 MW(e) nuclear power plant. Four seawater membrane manufacturers were supplied with feedwater analysis and a simplified cost estimating procedure in order to recommend membrane systems which would be applicable. For both sites a two-stage system was selected for development of a conceptual cost estimate. DOE

**N79-31439#** California Univ Berkeley Lawrence Berkeley Lab

**COMPUTER DESIGN AND OPTIMIZATION OF CRYOGENIC REFRIGERATION SYSTEMS**

M A Green, H S Pines, and P A Doyle Jun 1978 10 p refs Presented at the 7th Intern Conf of Eng., London, 4-7 Jul 1978

(Contract W-7405-eng-48)

(LBL-7934, Conf-780718-4) Avail NTIS HC A02/MF A01

The design and optimization of a cryogenic refrigerator using the LBL computer program GEOTHM are described. This computer program has been used extensively to design and optimize geothermal power plants and power cycles of other types. GEOTHM can calculate the thermodynamics of a wide variety of cycles including refrigeration cycles. GEOTHM has an optimizer which permits single step multiparameter optimization of a thermodynamic cycle. A refrigeration cycle may be optimized for minimum cost refrigeration or maximum thermodynamic performance using up to 55 optimizable parameters. The use of the optimizer in GEOTHM is demonstrated on two liquid nitrogen refrigeration cycles which are optimized for minimum refrigeration cost and minimum input power. DOE

**N79-31513#** AEG-Telefunken Wedel (West Germany) Abt Raumfahrt-Elektronik

**ASSESSMENT OF SHORT AND MEDIUM TERM IMPROVEMENTS TO THE SPACELAB POWER SYSTEM**

26 Oct 1978 56 p 2 Vol

(Contract ESA-3538/78-F-HEW(SC))

(ESA-CR(P)-1193-Vol-2) Avail NTIS HC A04/MF A01

The results of a study to improve Spacelab's baseline electrical power and distribution system (EPDS) are presented. An additional 3 kW power source for experiment power augmentation is discussed, including the analysis of fuel cell kits as add-on power modules. A solar array subsystem, technical descriptions, and a cost/schedule assessments are also discussed. Author (ESA)

**N79-31706\*** National Aeronautics and Space Administration Marshall Space Flight Center Huntsville, Ala  
**COAL-ROCK INTERFACE DETECTOR**

Stephen D Rose, Charles E Crouch, and Elborn W Jones, inventors (to NASA) (Mississippi State Univ., Mississippi State) 21 Aug 1979 8 p Filed 4 Nov 1977

(NASA-Case-MFS-23725-1, US-Patent-4,165,460,

US-Patent-Appl-SN-848793 US-Patent-Class-250-253,

US-Patent-Class-250-272) Avail US Patent and Trademark Office CSCL 081

A coal-rock interface detector is presented which employs a radioactive source and radiation sensor. The source and sensor are separately and independently suspended and positioned against a mine surface of hydraulic pistons, which are biased from an air cushioned source of pressurized hydraulic fluid.

Official Gazette of the U S Patent and Trademark Office

**N79-31720\*#** ECON, Inc. Princeton N J

**STATUS OF SEASAT COMMERCIAL DEMONSTRATION PROGRAM**

Larrain Luckl and B P Miller Principal Investigators Dec 1978

86 p refs Workshop held at Pasadena Calif 31 Oct - 1 Nov 1978 Sponsored by NASA ERTS

(E79-10260 NASA-CR-158875, ECON-78-292) Avail NTIS

HC A05/MF A01 CSCL 17B

**N79-31730\*#** Stanford Univ., Calif School of Applied Earth Sciences

**GEOLOGICAL AND GEOTHERMAL DATA USE INVESTIGATIONS FOR APPLICATION EXPLORER MISSION-A, HEAT CAPACITY MAPPING MISSION Quarterly Report, 1 Nov. 1978 - 28 Feb. 1979**

R J P Lyon and A E Prelat, Principal Investigators 28 Feb 1979 2 p ERTS

(Contract NAS5-24232)

(E79-10273, NASA-CR-162094)

Avail NTIS

HC A02/MF A01 CSCL 08B

**N79-31731\*#** Stanford Univ., Calif School of Applied Earth Sciences

**GEOLOGICAL AND GEOTHERMAL DATA USE INVESTIGATIONS FOR APPLICATION EXPLORER MISSION-A, HEAT CAPACITY MAPPING MISSION Quarterly Report, 1 Mar - 30 Jun 1979**

R J P Lyon and J C Broderick, Principal Investigators 30 Jun 1979 2 p ERTS

(Contract NAS5-24232)

(E79-10274, NASA-CR-162095)

Avail NTIS

HC A02/MF A01 CSCL 08B

**N79-31737\*#** ECON Inc., Princeton N J

**SEASAT-A ASVT COMMERCIAL DEMONSTRATION EXPERIMENTS RESULTS ANALYSIS METHODOLOGY FOR THE SEASAT-A CASE STUDIES**

28 Aug 1979 62 p refs Revised

(Contract NASw-3047)

(NASA-CR-162162 DOC-79-292-2-Rev-2) Avail NTIS

HC A04/MF A01 CSCL 05B

The SEASAT-A commercial demonstration program ASVT is described. The program consists of a set of experiments involving the evaluation of a real time data distributions system, the SEASAT-A user data distribution system that provides the capability for near real time dissemination of ocean conditions and weather data products from the U S Navy Fleet Numerical Weather Central to a selected set of commercial and industrial users and case studies, performed by commercial and industrial users, using the data gathered by SEASAT-A during its operational life. The impact of the SEASAT-A data on business operations is evaluated by the commercial and industrial users. The approach followed in the performance of the case studies and the methodology used in the analysis and integration of the case

study results to estimate the actual and potential economic benefits of improved ocean condition and weather forecast data are described AWH

**N79-31741# Sandia Labs Albuquerque N Mex  
TRUE IN SITU PROCESSING OF OIL SHALE AN  
EVALUATION OF CURRENT BED PREPARATION TECH-  
NOLOGY**

R R Boade A L Stevens A Long, and A E Harak Mar 1979 88 p refs  
(Contract EY-76-C-04-0789)

(SAND-78-2162) Avail NTIS HC A05/MF A01

It is concluded that the wellbore springing and hydraulic/explosives fracturing concepts both have inherent traits which prohibit their practical application to deep oil shale seams. Difficulties with the wellbore springing concept stem largely from the cylindrical geometry which leads to rapidly attenuating stress waves (hence to comparatively small fractured regions) and to the creation of a residually stressed region around the explosive cavity that restricts fluid flow and hinders void redistribution efforts. Major problems with the hydraulic/explosive fracturing concept are that many operations cannot be controlled and that regions of enhanced permeability are formed only in the vicinity of explosive filled hydrofractures. The physical characteristics of a successful bed preparation concept are defined along with recommendations for a research oriented program to develop the technology necessary to achieve a successful true in situ retorting capability DOE

**N79-31743# Oak Ridge National Lab Tenn Chemical  
Technology Div**

**ENGINEERING ANALYSIS AND COMPARISON OF NEW  
PROCESSES FOR THE RECOVERY OF RESOURCE MATERI-  
ALS FROM COAL ASH**

R M Canon, F G Seeley, and J S Watson 1979 18 p  
refs Presented at the 5th Intern Ash Util Symp Atlanta  
25-27 Feb 1979

(Contract W-7405-eng-26)

(CONF-790205-3) Avail NTIS HC A02/MF A01

During the past 2 years, several promising new processes for the recovery of valuable resource materials from coal ash primarily power plant fly ash were conceived and investigated. These processes, which include direct acid leach, the salt-soda sinter process, and the Cal-sinter ( $\text{CaSO}_4\text{-CaCO}_3$ ) process are designed to remove the major metals (aluminum iron and titanium) from fly ash however, some are also capable of recovering trace metals DOE

**N79-31744# Sandia Labs, Albuquerque N Mex  
USE OF ELECTRICAL GEOPHYSICAL TECHNIQUES TO MAP  
AND MONITOR IN SITU OIL SHALE RECOVERY PROC-  
ESSES**

L C Bartel 1979 25 p refs Presented at 12th Oil Shale  
Symp, Golden Colo, 18 Apr 1979

(Contract EY-76-C-04-0789)

(SAND-79-0746C Conf-790440-2) Avail NTIS  
HC A02/MF A01

The electrical conducting property of the in situ coal gasification and oil shale retort reaction zones forms the basis for using electrical geophysical prospecting techniques to map and monitor these in situ processes. The electrical geophysical techniques include mise-a-la-masse, Schlumberger, and a borehole electrical survey. The field measurements are supported by extensive model calculation and data reduction efforts. The in situ coal gasification reaction boundaries were successfully delineated using the mise-a-la-masse technique and a ridge regression data inversion algorithm DOE

**N79-31745# Los Alamos Scientific Lab, N Mex  
ROCKY MOUNTAIN COAL FOR SOUTHERN CALIFORNIA'S  
COAL-FIRED ELECTRIC POWER GENERATION**

O L Anderson Feb 1979 144 p refs

(Contract W-7405-eng-36)

(LA-6915-MS) Avail NTIS HC A07/MF A01

A scaled-down version of a Study of Alternative Locations of Coal-Fired Electrical Generating Plants to Supply Western Coal

to the Department of Water Resources is reported. It covers three aspects of the major report (1) coal resources in the Upper Colorado Plateau (2) the possible transportation of those coal resources to southern California and (3) the cost analyses of the coal transportation. Descriptions of 92 coalfields within an 800 mile radius of the Los Angeles energy market are included. The general legal regulations governing the acquisition and development of coal from state, federal and private lands are discussed. The existing and potential methods of transporting the coal to southern California are also described DOE

**N79-31746# Dow Chemical Co Midland Mich Hydrocarbons  
and Energy Research Dept  
ENERGY FROM IN SITU PROCESSING OF ANTRIM OIL  
SHALE**

J P Humphrey 19 Jul 1979 44 p refs

(Contract EX-76-C-01-2346)

(FE-2346-29) Avail NTIS HC A03/MF A01

In situ combustion was maintained for a 61 day period while several continuous and cyclic production procedures were tested. Gas having energy values in the target range (150 Btu scf) was produced at various times although the flow rate at these times was minimal and hence the energy production was low. A hydraulic fracturing and sand propping program was completed in 100 Series wells. Preparations for explosive fracturing are essentially complete. The plans for the first explosive shot in the explosive underreaming experiment were completed and final preparations are underway. Shale characterization and resource inventory activities are continuing in four of the major universities of Michigan DOE

**N79-31756\*# Battelle Columbus Labs, Ohio  
EVALUATION OF SELECTED CHEMICAL PROCESSES FOR  
PRODUCTION OF LOW-COST SILICON, PHASE 3 Quarterly  
Progress Report, 1 Apr - 30 Jun 1979**

J M Blocher Jr and M F Browning 15 Aug 1979 18 p  
ref Sponsored in part by DOE Prepared for JPL

(Contracts NAS7-100 JPL-954339)

(NASA-CR-162168, DOE/JPL-954339-79/15, QPR-15) Avail  
NTIS HC A02/MF A01 CSCL 10A

The construction and operation of an experimental process system development unit (EPSDU) for the production of granular semiconductor grade silicon by the zinc vapor reduction of silicon tetrachloride in a fluidized bed of seed particles is presented. The construction of the process development unit (PDU) is reported. The PDU consists of four critical units of the EPSDU: the fluidized bed reactor, the reactor by product condenser, the zinc vaporizer and the electrolytic cell. An experimental wetted wall condenser and its operation are described. Procedures are established for safe handling of  $\text{SiCl}_4$  leaks and spills from the EPSDU and PDU AWH

**N79-31758\*# RCA Labs Princeton N J  
EPITAXIAL SILICON GROWTH FOR SOLAR CELLS Final  
Report**

R V DAiello, P H Robinson, and D Richman Apr 1979  
66 p refs Prepared for DOE and JPL

(Contracts NAS7-100, JPL-954817)

(NASA-CR-162177, DOE/JPL-954817-79/4) Avail NTIS  
HC A04/MF A01 CSCL 10A

The epitaxial procedures solar cell fabrication and evaluation techniques are described. The development of baseline epitaxial solar cell structures grown on high quality conventional silicon substrates is discussed. Diagnostic layers and solar cells grown on four potentially low cost silicon substrates are considered. The crystallographic properties of such layers and the performance of epitaxially grown solar cells fabricated on these materials are described. An advanced epitaxial reactor, the rotary disc is described along with the results of growing solar cell structures of the baseline type on low cost substrates. The add on cost for the epitaxial process is assessed and the economic advantages of the epitaxial process as they relate to silicon substrate selection are examined AWH



**N79-31759\*#** RCA Labs, Princeton, N J  
**AUTOMATED ARRAY ASSEMBLY, PHASE 2 Quarterly Report**  
 R V DAiello Jun 1979 36 p refs Prepared for DOE and JPL  
 (Contracts NAS7-100, JPL-954868)  
 (NASA-CR-162176, DOE/JPL-954868-79/7, QR-6) Avail  
 NTIS HC A03/MF A01 CSCL 10A

The large scale production of silicon solar cell array panels is discussed. The cost and performance of three manufacturing sequences designed to convert silicon sheet and wafers into solar panels is analyzed. The production of ion implanted and furnace annealed solar cells made using solar grade n- and p-type wafers is examined. The performance of production size lots is examined with regard to the relationship between the ion implant and furnace anneal parameters and the ability to form consistently good thick film screen printed contacts. The spray on antireflection coating process is evaluated. The performance of several lots of cells before and after coating is measured. The structure and refractive index of the RCA I (TiO<sub>2</sub>) coating is compared with commercial solutions. Sensitivity of coated, screen printed cells to the post heat treatment required to cure the films is assessed. AWH

**N79-31762\*#** Westinghouse Research and Development Center, Pittsburgh, Pa  
**SILICON WEB PROCESS DEVELOPMENT Quarterly Report, 20 Apr. - 30 Jun. 1979**  
 C S Duncan, R G Seidensticker, R H Hopkins, J P McHugh, F E Hill, M E Heimlich, and J M Driggers 30 Jun 1979 55 p refs Sponsored by NASA Prepared for DOE and JPL (Contract JPL-954654)  
 (NASA-CR-162181, DOE/JPL-954654-79/3) Avail NTIS HC A04/MF A01 CSCL 10A

Silicon dendritic web, ribbon form of silicon and capable of fabrication into solar cells with greater than 15% AMI conversion efficiency, was produced from the melt without die shaping. Improvements were made both in the width of the web ribbons grown and in the techniques to replenish the liquid silicon as it is transformed to web. Through means of improved thermal shielding stress was reduced sufficiently so that web crystals nearly 4.5 cm wide were grown. The development of two subsystems, a silicon feeder and a melt level sensor, necessary to achieve an operational melt replenishment system, is described. A gas flow management technique is discussed and a laser reflection method to sense and control the melt level as silicon is replenished is examined. AWH

**N79-31763\*#** TRW Systems Group, Redondo Beach, Calif  
 Manufacturing Div  
**STUDY OF AUTOMATED MODULE FABRICATION FOR LIGHTWEIGHT SOLAR BLANKET UTILIZATION Final Report**  
 Charles E Gibson May 1979 79 p refs Prepared for JPL (Contracts NAS7-100, JPL-955205)  
 (NASA-CR-162157, TRW-79 5536 3-06) Avail NTIS HC A05/MF A01 CSCL 10A

Cost-effective automated techniques for accomplishing the titled purpose, based on existing in-house capability are described. As a measure of the considered automation, the production of a 50 kilowatt solar array blanket, exclusive of support and deployment structure, within an eight-month fabrication period was used. Solar cells considered for this blanket were 2 x 4 x .02 cm wrap-around cells, 2 x 2 x .005 cm and 3 x 3 x .005 cm standard bar contact thin cells, all welded contacts. Existing fabrication processes are described, the rationale for each process is discussed, and the capability for further automation is discussed. GY

**N79-31764\*#** Chicago Univ., Ill Enrico Fermi Inst  
**WINSTON SOLAR CONCENTRATORS AND EVALUATION SUPPORT, PHASE 2: NON-IMAGING CONCENTRATORS FOR SPACE APPLICATIONS Final Report, Oct. 1977 - Jul 1978**  
 Roland Winston, Joseph O'Gallagher, and Peretz Greenman 28 Aug 1978 81 p refs Prepared for JPL

(Contract JPL-954563)  
 (NASA-CR-162279) Avail NTIS HC A05/MF A01 CSCL 10A

A 4.67X, plus or minus 5 deg compound parabolic concentrator (CPC) for a large photovoltaic array in space was analyzed. The design was demonstrated to be effective in achieving a net power gain which can be varied from more than a factor of 3 down to approximately unity. A method for reducing nonuniformities in illumination to a given desired level was found. The effectiveness of this method, which involves the introduction of a degree of non-specularity in the reflector surface, was confirmed by direct measurements with prepared foil reflectors in a CPC in terrestrial sunshine as well as by computer ray tracing. Further ray tracing confirms that the CPC design is extremely tolerant to pointing and alignment errors, minor distortions, etc. A two stage non-imaging design was shown by preliminary measurements and analysis, to provide both the desired angular tolerance and the required degree of intensity uniformity if higher concentrations (4X-10X) are necessary. Author

**N79-31765\*#** Solarex Corp., Rockville, Md  
**HIGH EFFICIENCY, HIGH DENSITY TERRESTRIAL PANEL Final Report**

John Wohlgemuth, Manfred Wihl, and Thomas Rosenfield Feb 1979 70 p Sponsored in part by DOE Prepared for JPL (Contract JPL-954822)  
 (NASA-CR-162167, DOE/JPL-954822-78/1) Avail NTIS HC A04/MF A01 CSCL 10A

Terrestrial panels were fabricated using rectangular cells. Packing densities in excess of 90% with panel conversion efficiencies greater than 13% were obtained. Higher density panels can be produced on a cost competitive basis with the standard salami panels. KL

**N79-31767\*#** Solarex Corp., Rockville, Md  
**DEVELOPMENT OF AN IMPROVED HIGH EFFICIENCY THIN SILICON SOLAR CELL Quarterly Report**  
 G Storti and C Wrigley Jul 1979 18 p Prepared for JPL (Contracts NAS7-100, JPL-954883)  
 (NASA-CR-162159, SX/115/7Q, QR-7) Avail NTIS HC A02/MF A01 CSCL 10A

Breakage and front contact failure in high efficiency, textured ultrathin cells was reduced as a consequence of the introduction of process modifications. In a small production run, over one hundred ultrathin cells, having an average AMO efficiency of 13%, were fabricated from 10-25 ohm cm silicon. An in-house aluminum paste for back surface field formation was developed that resulted in cell efficiencies equivalent to those from commercial pastes. The quality of the back surface field was found to be dependent on the orientation of the silicon slice during alloying. GY

**N79-31769\*#** Pennsylvania Univ Philadelphia School of Electrical Engineering  
**ANALYSIS AND EVALUATION IN THE PRODUCTION PROCESS AND EQUIPMENT AREA OF THE LOW-COST SOLAR ARRAY PROJECT Quarterly Report, Jan. - Apr. 1979**

H Goldman and M Wolf Jun 1979 176 p refs Sponsored by NASA and DOE Prepared for JPL (Contract JPL-954796)  
 (NASA-CR-162163, DOE/JPL-954796-79/6) Avail NTIS HC A09/MF A01 CSCL 10A

The manufacturing methods for photovoltaic solar energy utilization are assessed. Economic and technical data on the current front junction formation processes of gaseous diffusion and ion implantation are presented. Future proposals, including modifying gaseous diffusion and using ion implantation, to decrease the cost of junction formation are studied. Technology developments in current processes and an economic evaluation of the processes are included. AWH

**N79-31771\*#** Sensor Technology, Inc., Chatsworth, Calif  
**AUTOMATED ARRAY ASSEMBLY TASK IN-DEPTH STUDY OF SILICON WAFER SURFACE TEXTURIZING Quarterly Technical Report, 14 Dec. 1978 - 31 Mar. 1979**

Gregory T Jones Sanjeev Chitre, Sang S Rhee, and Kimberly L Allison Mar 1979 51 p refs Sponsored by NASA and DOE Prepared for JPL  
(Contract JPL-955266)

(NASA-CR-162161, DOE/JPL-955266-79/1 QTR-1) Avail NTIS HC A04/MF A01 CSCL 10A

A low cost wafer surface texturizing process was studied. An investigation of low cost cleaning operations to clean residual wax and organics from the surface of silicon wafers was made. The feasibility of replacing dry nitrogen with clean dry air for drying silicon wafers was examined. The two stage texturizing process was studied for the purpose of characterizing relevant parameters in large volume applications. The effect of gettering solar cells on photovoltaic energy conversion efficiency is described. A W H

**N79-31772\*#** Materials Research, Inc., Centerville, Utah  
**QUANTITATIVE ANALYSIS OF DEFECTS IN SILICON**  
**Quarterly Progress Report, 1 Apr - 31 Jun. 1979**

R Natesh, J M Smith, H A Qidwai, and T Bruce 12 Jul 1979 177 p refs Sponsored by NASA Prepared for DOE and JPL

(Contract JPL-954977)

(NASA-CR-162173 MRI-273, QPR-5)

DOE/JPL-954977-79/6) Avail NTIS HC A09/MF A01 CSCL 10A

The evaluation and prediction of the conversion efficiency for a variety of silicon samples with differences in structural defects such as grain boundaries, twin boundaries, precipitate particles, dislocations, etc are discussed. Quantitative characterization of these structural defects, which were revealed by etching the surface of silicon samples is performed by using an image analyzer. Due to different crystal growth and fabrication techniques the various types of silicon contain a variety of trace impurity elements and structural defects. The two most important criteria in evaluating the various silicon types for solar cell applications are cost and conversion efficiency. A W H

**N79-31773\*#** Sensor Technology, Inc., Chatsworth, Calif  
**ARRAY AUTOMATED ASSEMBLY TASK LOW COST SILICON SOLAR ARRAY PROJECT, PHASE 2 Annual Technical Report**

Sang S Rhee, Gregory T Jones, and Kimberly L Allison 1978 187 p refs Sponsored by NASA Prepared for DOE and JPL (Contract JPL-954865)

(NASA-CR-162174, DOE/JPL-954865-79/5) Avail NTIS HC A09/MF A01 CSCL 10A

Progress in the development of solar cells and module process steps for low-cost solar arrays is reported. Specific topics covered include (1) a system to automatically measure solar cell electrical performance parameters, (2) automation of wafer surface preparation, printing, and plating, (3) laser inspection of mechanical defects of solar cells, and (4) a silicon antireflection coating system. Two solar cell process steps, laser trimming and holing automation and spray-on dopant junction formation, are described. K L

**N79-31775\*#** Crystal Systems, Inc., Salem, Mass  
**SILICON INGOT CASTING, HEAT EXCHANGER METHOD, MULTI-WIRE SLICING, FIXED ABRASIVE SLICING TECHNIQUE, PHASE 3 Quarterly Progress Report, 1 Apr. - 30 Jun 1979**

Frederick Schmid and Chandra P Khattak Jun 1979 34 p refs Sponsored by NASA Prepared for DOE and JPL (Contract JPL-954373)

(NASA-CR-162182, DOE/JPL-954373-79/11 QPR-3) Avail NTIS HC A03/MF A01 CSCL 10A

Ingot casting was scaled up to 16 cm by 16 cm square cross section size and ingots weighing up to 81 kg were cast. The high degree of crystallinity was maintained in the large ingot. For large sizes, the nonuniformity of heat treatment causes chipping of the surface of the ingot. Progress was made in the development of a uniform graded structure in the silica crucibles. The high speed slicer blade-head weight was reduced to 37 pounds, allowing surface speeds of up to 500 feet per minute. Slicing of 10 cm diameter workpieces at these speeds increased the through-put of the machine to 0.145 mm/min. K L

**N79-31776\*#** Honeywell Corporate Material Sciences Center  
Bloomington, Minn

**SILICON-ON CERAMIC PROCESS SILICON SHEET GROWTH AND DEVICE DEVELOPMENT FOR THE LARGE-AREA SILICON SHEET AND CELL DEVELOPMENT TASKS OF THE LOW-COST SOLAR ARRAY PROJECT Quarterly Report, 2 Apr - 29 Jun 1979**

P W Chapman, J D Zook, J D Heaps, B L Grung B Koepke, and S B Schuldt 31 Jul 1979 66 p refs Sponsored in part by DOE Prepared for JPL

(Contracts NAS7-100 JPL-954356)

(NASA-CR-162158, DOE/JPL-954356-79/2 QR-12) Avail NTIS HC A04/MF A01 CSCL 10A

The technical and economic feasibility of producing solar cell-quality silicon was investigated. This was done by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. Significant progress in the following areas was demonstrated: (1) fabricating a 10 sq cm cell having 9.9 percent conversion efficiency; (2) producing a 225 sq cm layer of sheet silicon; and (3) obtaining 100 microns thick coatings at pull speed of 0.15 cm/sec although approximately 50 percent of the layer exhibited dendritic growth. G Y

**N79-31777\*#** Union Carbide Corp., New York  
**LOW-COST SOLAR ARRAY PROJECT, FEASIBILITY OF THE SILANE PROCESS FOR PRODUCING SEMICONDUCTOR-GRADE SILICON Final Report, Oct 1975 - Mar. 1979**

Jun 1979 362 p refs Prepared for JPL

(Contracts NAS7-100 JPL-954334)

(NASA-CR-162172) Avail NTIS HC A16/MF A01 CSCL 10A

The feasibility of Union Carbide's silane process for commercial application was established. An integrated process design for an experimental process system development unit and a commercial facility were developed. The corresponding commercial plant economic performance was then estimated. R E S

**N79-31779\*#** National Aeronautics and Space Administration  
Washington, D C

**INVESTIGATION OF A GENERATOR SYSTEM FOR GENERATING ELECTRICAL POWER, TO SUPPLY DIRECTLY TO THE PUBLIC NETWORK, USING A WINDMILL**

C Tromp Aug 1979 159 p refs Transl into ENGLISH of "Onderzoek aan een Generatorsysteem voor het Opwekken van, Direkt aan het Openbare Net te Leveren Elektrische Energie Net Behulp van een Windmolen Delft Univ of Technol, Power Electron Lab Netherlands, May 1957 122 p Transl by Kanner (Leo) Associates Redwood City, Calif (Contract NASw-3199)

(NASA-TM-75497) Avail NTIS HC A08/MF A01 CSCL 10B

A windpowered generator system is described which uses a windmill to convert mechanical energy to electrical energy for a three phase (network) voltage of constant amplitude and frequency. The generator system controls the windmill by the number of revolutions so that the power drawn from the wind for a given wind velocity is maximum. A generator revolution which is proportional to wind velocity is achieved. The stator of the generator is linked directly to the network and a feed converter at the rotor takes care of constant voltage and frequency at the stator. A W H

**N79-31780\*#** Alabama Univ., University Dept of Physics and Astronomy

**DEVELOPMENT OF SURFACES OPTICALLY SUITABLE FOR FLAT SOLAR PANELS Final Report**

Aug 1979 46 p refs Prepared for DOE

(Contract NAS8-32481)

(NASA-CR-161290) Avail NTIS HC A03/MF A01 CSCL 10A

A reflectometer which can separately evaluate the spectral and diffuse reflectivities of surfaces is described. A phase locked detection system for the reflectometer is also described. A selective coating on aluminum potentially useful for flat plate solar collector

applications is presented. The coating is composed of strongly bound copper oxide (divalent) and is formed by an etching process performed on an aluminum alloy with high copper content. Fabrication costs are expected to be small due to the one stop fabrication process. A number of conclusions gathered from the literature as to the required optical properties of flat plate solar collectors are discussed. A W H

**N79-31781\*** National Aeronautics and Space Administration  
Lewis Research Center, Cleveland, Ohio  
**DISCHARGE CHARACTERISTICS OF 300 AMPERE-HOUR  
Ni-Zn TRACTION CELLS**  
John G. Ewashinka, Aug 1979, 11 p.  
(NASA-TM-79244, E-151) Avail NTIS HC A02/MF A01 CSCL 10C

Preliminary tests were performed on 300 ampere-hour nickel-zinc cells containing the Lewis improved inorganic-organic (I/O) separator. These cells also have other design features included to optimize performance and cycle life. The tests carried out were formation tests and characteristic discharge tests. Information obtained includes case temperature and maximum power delivered. A R H

**N79-31782\*** Scientific Service Inc., Redwood City, Calif.  
**OPPORTUNITIES FOR ENERGY CONSERVATION IN  
FINISHED CONCRETE PRODUCTS. Final Report**  
J. V. Zaccor and J. Jewett, Sep 1978, 104 p, refs.  
(Contract EC-77-S-03-1549)  
(HCP/CS-1549) Avail NTIS HC A06/MF A01

Two energy conservation opportunities are identified as applicable to the finished concrete products industry. One involves substituting a naturally cementitious material, pozzolan, for a portion of the cement, and the other involves the application of an appropriate insulation to achieve thermal isolation of material needlessly cycled with the product. A W H

**N79-31783\*** Edgerton, Germeshausen and Grier Inc., Idaho Falls, Idaho  
**ENERGY CONSERVATION WITH FIRED HEATERS**  
Neil G. Cox and W. Paul Jensen, Dec 1978, 65 p, refs.  
(Contract EY-76-C-07-1570)  
(TREE-1308) Avail NTIS HC A04/MF A01

The energy consumption and the energy conservation potential with the operation of fired heaters in the petroleum refining and petrochemical industries are examined. Data were gathered to estimate the current and anticipated energy usage of fired heaters. The progress made in energy conservation efforts by the industries is assessed. Energy conservation limits with current technology are estimated and any needed for furthering energy conservation in the use of fired heaters is identified. A W H

**N79-31784\*** United Technologies Corp., South Windsor, Conn.  
Power Systems Div.  
**STRIP CELL TEST AND EVALUATION PROGRAM. Final  
Report, 15 Jun 1976 - 30 Apr 1977**  
B. Gitlow, W. F. Bell, and R. E. Martin, 27 Oct 1978, 76 p, refs.  
(Contract NAS3-20042)  
(NASA-CR-159652, FCR-0945) Avail NTIS  
HC A05/MF A01 CSCL 10B

The performance characteristics of alkaline fuel cells to be used for space power systems were tested. Endurance tests were conducted on the cells during energy conversion operations. A feature of the cells fabricated and tested was the capability to evaporate the product water formed during the energy conversion reaction directly to space vacuum. A fuel cell powerplant incorporating these cells does not require a condenser and a hydrogen recirculating pump/water separator to remove the product water. This simplified the fuel cell powerplant system, reduced the systems weight, and reduced the systems parasitic power. A W H

**N79-31787\*** Brookhaven National Lab., Upton, N. Y.  
**SOAR (SOLAR ASSISTED REACTOR) POWER SYSTEM**  
R. F. Benenati and J. R. Powell, 1979, 5 p, ref. Presented at the ANS Ann. Meeting, Atlanta, 3 Jun 1979.

(Contract EY-76-C-02-0016)  
(BNL-25633, Conf-790602-29) Avail NTIS  
HC A02/MF A01

The concept of utilizing solar energy as a supplementary energy source for hybrid power plants in which the main input is nuclear or coal is discussed. Low and intermediate temperature solar collectors can supply feedwater heat and/or reheat steam after expansion in a high pressure turbine. The Comanche Peak nuclear plant was selected for the study. A flowsheet with all feedwater heaters and the steam reheater using solar heat is given. The increased plant output is plotted as a function of the number of solar feedwater heaters. Author (DOE)

**N79-31788\*** Illinois Univ., Urbana  
**ENERGY AND LABOR INTENSITIES PROJECTED TO THE  
YEAR 2010**

B. Hannon and A. R. Pleskun, Sep 1978, 162 p, refs.  
(Contract EM-78-S-02-4628)  
(COO-4628-2) Avail NTIS HC A08/MF A01

Total (direct and indirect) energy and labor intensities were projected to the year 2000 for a 40-sector economy. Energy intensities were derived by modifying the CONAES results with four possible energy price change scenarios between 1975 and 2010. Labor intensities were projected using data from the CAC model and projected BLS matrices to approximate the effect of a doubling of energy prices between 1975 and 2010. As an illustrative example, the projected data were used to determine the net energy and employment impacts of the National Energy Plan on residential energy use to the year 2000. DOE

**N79-31789\*** Argonne National Lab., Ill.  
**SOLAR ENERGY PROGRAM. Annual Report, 1978**  
Feb 1979, 95 p, refs.  
(Contract W-31-109-eng-38)  
(ANL-79-16) Avail NTIS HC A05/MF A01

The work done at Argonne National Laboratory on the Solar Energy Program during FY 1978 (July 1, 1977 to June 30, 1978) is described. Areas included in this report are solar energy collection, heating and cooling, thermal energy storage, ocean thermal energy conversion, photovoltaics, satellite power systems, bioconversion, central receiver solar thermal power, and wind energy conversion. DOE

**N79-31790\*** Department of Energy, Washington, D. C.  
Energy Information Administration  
**END-USE ENERGY-CONSUMPTION DATA BASE  
VERSION 10. USER'S MANUAL**  
M. Maloney, Feb 1979, 94 p, refs.  
(DOE/EIA-0175) Avail NTIS HC A05/MF A01

The end use energy consumption data base contains estimates of United States energy consumption categorized by fuel type, section of the economy, end use, and geographic area. Eight sectors are considered: agriculture, mining, construction, manufacturing, transportation, commercial, household, and electric utilities. Consumption estimates are at the national, census-division, and state levels, except for the household and commercial sectors, which are only at the national and census-division levels. The version of the data base described by this manual (version 110) contains consumption estimates for 1967, 1971, and 1974. The commercial sector estimates are for 1974 only. Future versions will contain estimates for 1975. The data base exists in two forms: as a sequential file on tape and as a random access file on computer. The random access file must be accessed by use of the data base management system. DOE

**N79-31791\*** Brookhaven National Lab., Upton, N. Y.  
National Center for Analysis of Energy Systems  
**LONG-TERM STRATEGIC ANALYSIS (TOWARDS AN  
ENERGY DOCTRINE)**

Kenneth C. Hoffman and Steven C. Carhart, Nov 1978, 30 p, refs. Presented at the Intern. Sci. Form. on an Acceptable World Energy Future, Miami, 27 Nov - 1 Dec 1978.  
(Contract EY-76-C-02-0016)  
(BNL-25250, Conf-781129-1) Avail NTIS HC A03/MF A01

The formulation of long-term energy strategies requires the synthesis of a large number of economic, social, technical, and

environmental factors with due regard to regional and international needs and constraints. An approach to strategic analysis in the energy sector is outlined. Emphasis is placed on the logic of the approach to strategic planning and analysis. DOE

**N79-31792#** Department of Energy, Washington D C Office of the Controller

**DEPARTMENT OF ENERGY FY 1980 OBLIGATIONS**

5 Feb 1979 341 p

(DOE/CR-0005) Avail NTIS HC A15/MF A01

Detailed estimates are shown for the respective states based on existing contracts and grants which were assumed to continue in 1980. Some programs could not be identified at the contractor level, and some elements of programs could not be identified by states. These are listed in an undesignated category. DOE

**N79-31793#** Argonne National Lab III  
**HIGH-PERFORMANCE BATTERIES FOR ELECTRIC-VEHICLE PROPULSION AND STATIONARY ENERGY STORAGE Progress Report, Oct. 1977 - Sep 1978**

P A Nelson, D L Barney and R K Steunenberg Nov 1978 246 p refs

(Contract W-31-109-eng-38)

(ANL-78-94) Avail NTIS HC A11/MF A01

High-temperature batteries for electric vehicle propulsion and stationary energy storage applications were developed. The cells, which operate at 400 to 500 C, are of a vertically oriented prismatic design with one or more inner positive electrodes of FeS or FeS<sub>2</sub> facing electrodes of lithium-aluminum alloy and molten LiCl KCl electrolyte. Development of a 40 kWh battery (Mark 1A) for testing in an electric van was initiated and conceptual design studies on a 100 MWh stationary energy storage module were conducted. Multiplate cells, which are capable of higher performance than bicells were developed. DOE

**N79-31794#** Department of Energy, Washington D C  
**SOLAR THERMAL POWER SYSTEMS, PROGRAM SUMMARY**

Dec 1978 280 p refs

(DOE/ET-0078) Avail NTIS HC A13/MF A01

Each of DOE's Solar Thermal Power Systems projects funded and/or in existence during FY 1978 is described and the status as of September 30 1978 is reflected. These projects are divided as follows: small thermal power applications, large thermal power applications, and advanced thermal technology. Also included are 1978 project summary tables, bibliography, and an alphabetical index of contractors. DOE

**N79-31795#** TRW Inc., McLean Va Energy Systems Planning Div

**ANALYSIS OF INVESTMENT ALTERNATIVES TO STIMULATE DEVELOPMENT AND TECHNOLOGY TRANSFER FOR ENERGY TECHNOLOGIES, SOLAR PHOTOVOLTAICS, A CASE STUDY**

Sep 1978 151 p refs

(Contract ET-78-C-05-5670)

(TID-28968) Avail NTIS HC A08/MF A01

The return on investment that could be achieved by building a plant with the aid of six types of incentives was simulated based on five distinct plant designs. Descriptions and results of these analyses are presented. The general decision tree analysis in which other options are considered is illustrated. Using the residential market as a testbed and for a variety of types or applications within the residential market, the significance of the balance-of-system costs issue is addressed in some detail. A survey of the photovoltaic industry is presented and the potential impact of incentives on the future competitiveness of the industry is discussed. Details of the methodology used to simulate corporate responses to incentive programs and computational details for balance-of-system costs are presented. DOE

**N79-31796#** Sandia Labs Albuquerque, N Mex  
**SUMMARY OF APPLICATION ANALYSIS FOR PHOTOVOLTAIC SYSTEMS**

G J Jones and J L Watkins 1979 12 p refs Presented at DOE Battery Storage Workshop Denver Colo, 11 Jan 1979

(Contract EY-76-C-04-0789)

(SAND-78-0980C, Conf-790138-1)

Avail NTIS

HC A02/MF A01

The cost effectiveness of consumer-owned photovoltaic systems was analyzed. The results indicate cost effectiveness in many regions in 1986 and everywhere by 2000, providing DOE price goals are met and battery storage is considered an integral part of only smaller (residential, remote) photovoltaic systems. The economic justification of battery storage in larger systems, especially utility owned ones is relatively independent of the presence of the photovoltaic array. The greatest general area of uncertainty in all sectors is the utility-customer interface for consumer owned systems and the worth of the photovoltaic system to the utility for utility owned systems. DOE

**N79-31797#** Department of Energy Washington D C  
**DOMESTIC POLICY REVIEW OF SOLAR ENERGY**

Feb 1979 146 p

(TID-28834) Avail NTIS HC A07/MF A01

Solar technologies and government policy towards competing fuels were assessed and existing Federal solar energy programs were evaluated. Solar energy's potential contributions to national and international needs are identified. Three options for future government policy are presented and specific initiatives which could be adopted to implement each are described. DOE

**N79-31798#** Department of Energy Washington D C Energy Information Administration

**MACROECONOMIC AND SECTOR IMPLICATIONS OF INSTALLING 2.2 MILLION RESIDENTIAL SOLAR UNITS**

R F Earley, M M Mohtadi, E L Rossidivito and H Weisman Apr 1979 102 p refs

(DOE/EIA-0102/51) Avail NTIS HC A06/MF A01

The macroeconomic sector and employment implications of cumulatively installing 2.2 million solar heating and hot water units through 1985 are analyzed. K L

**N79-31799#** Midwest Research Inst Golden Colo  
**IMPLEMENTATION OF STATE SOLAR INCENTIVES RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAMS**

B Green Feb 1979 41 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-51-161) Avail NTIS HC A03/MF A01

The states view high-risk capital-intensive R D and D solar projects as being most appropriately performed by the federal government and private industry. For the states, solar energy R D, and D programs function primarily in support of commercialization efforts. The close programmatic relationship between solar energy R D and D and commercialization efforts at the state level is a function of a more-immediate or near-term emphasis within state-level programs. Some states perceive their solar energy R D, and D programs as predominantly a commercialization activity. Available R D and D incentives at the state level are reviewed and the implementation of research programs in New Mexico, Montana, California, and Florida is described. The following are included: a catalog of state solar energy R D and D programs; the choice of case-study states; program-implementation experience in the case-study states; and observations, recommendations and conclusions. DOE

**N79-31800#** Midwest Research Inst Golden Colo  
**ROLE OF EDUCATION AND TRAINING PROGRAMS IN THE COMMERCIALIZATION AND DIFFUSION OF SOLAR ENERGY TECHNOLOGIES**

B Burns, B Mason, and K Armington Jan 1979 56 p refs

(Contract EG-77-C-01-4042)

(SERI/RR-53-128) Avail NTIS HC A04/MF A01

An important part of analyzing employment and labor force requirements in the solar energy field is determining the availability of trained and experienced workers and of programs to provide additional training. A base for analysis of these labor force supply questions by identifying the importance of education and training in the commercialization and diffusion of solar technologies is provided. Issues for planning and analysis of solar education and training efforts are discussed, and the range of programs and courses presently available is illustrated. Four general

perspectives are reviewed, on the diffusion of a new technology such as solar energy systems, with special attention to the education and training issues DOE

**N79-31801#** Argonne National Lab. III  
**ASSESSMENT OF NATIONAL CONSEQUENCES OF INCREASED COAL UTILIZATION, EXECUTIVE SUMMARY, VOLUME 1**

Feb 1979 89 p refs Prepared in cooperation with BNL, California Univ., Berkeley Lawrence Berkeley Lab LASL, ORNL, and Battelle Pacific Northwest Labs Sponsored by DOE (TID-29425-Vol-1) Avail NTIS HC A05/MF A01

Environmental constraints to reaching the coal use goals of the NEP were analyzed. The major constraint, air quality, arises primarily because of the postulated siting of power plants and coal-burning industries in or near areas where air quality standards are currently violated and prevention of significant deterioration class 1 and 2 areas. Further air quality constraints may arise from potential short-term violations of National Ambient Air Quality Standards for total suspended particulates and SO<sub>2</sub>. These constraints may affect 35 percent of projected for the NEP. Other constraints discussed are long range sulfur transport as dioxide and sulfates, health effects of air pollution, water quality and availability, solid waste disposal, socio-economic effects, economics (capital and labor investment required), occupational health and safety (accidents in mining and transporting coal), etc. DOE

**N79-31802#** Argonne National Lab. III  
**ASSESSMENT OF NATIONAL CONSEQUENCES OF INCREASED COAL UTILIZATION, EXECUTIVE SUMMARY, VOLUME 2**

Feb 1979 346 p refs Prepared in cooperation with BNL, California Univ., Berkeley Lawrence Berkeley Lab LASL, ORNL, and Battelle Pacific Northwest Labs Sponsored by DOE (TID-29425-Vol-2) Avail NTIS HC A15/MF A01

The constraints to reaching National Energy Plan (NEP) coal use goals were analyzed. The major constraint, air quality, involves the siting of utility and industrial sources in or near nonattainment areas or prevention of significant deterioration class 1 and 2 areas. Further restrictions arise from potential short term SO<sub>2</sub> and total suspended particulates National Ambient Air Quality Standards violations. Implementation of NEP initiatives should not cause major public health impacts. Water quality and water availability constraints on site specific bases are expected. Solid waste does not appear to be a constraint for achieving NEP coal use goals. Neither national economic nor regional socio-economic impacts appear to cause major restrictions. There may be socioeconomic impacts on a local basis where large scale energy facilities will be located in areas of low assimilative capacity. DOE

**N79-31803#** AIA Research Corp., Washington, D. C.  
**PASSIVE SOLAR DESIGN A SURVEY OF MONITORED BUILDINGS**

Oct 1978 360 p refs  
 (Contract EG-77-C-01-4113)  
 (HCP/CS-4113-2) Avail NTIS HC A16/MF A01

This survey consists of collected articles reporting the thermal performance of buildings using passive solar techniques, plus a matrix tabulating the information contained in the reports, and a verbal summary of the results. Most of the articles were published previously; additional information was gathered from owners and designers and is attached as an addendum to the articles. DOE

**N79-31804#** AIA Research Corp., Washington, D. C.  
**PASSIVE SOLAR DESIGN AN EXTENSIVE BIBLIOGRAPHY**

Dec 1978 210 p  
 (Contract EG-77-C-01-4113)  
 (HCP/CS-4113-3) Avail NTIS HC A10/MF A01

Approximately 2445 citations on passive solar design are presented. Materials included in major data banks as of January 1978 are included along with the proceedings of the Second National Passive Conference. Subject areas include agriculture,

costs, design concepts, greenhouses, energy storage, and evaporation. DOE

**N79-31805#** Midwest Research Inst., Golden, Colo.  
**CLASSIFICATION SCHEME FOR THE COMMON PASSIVE AND HYBRID HEATING AND COOLING SYSTEMS**

Michael J. Holtz, W. Place (California Univ., Berkeley Lawrence Berkeley Lab), and R. C. Kammerud (California Univ., Berkeley Lawrence Berkeley Lab) Feb 1979 9 p refs Presented at 3d Natl. Passive Solar Conf., San Jose, Calif., 11 Jan 1979 (Contract W-7405-eng-48)

(LBL-8814 Conf-790118-6) Avail NTIS HC A02/MF A01

A systematic nomenclature and classification scheme is proposed for passive space heating and cooling systems. It is based upon the mode of energy transport to and from the space and the environmental resource from which the energy is received or to which it is discharged. A number of passive and hybrid space heating and cooling systems are characterized. DOE

**N79-31806#** Sandia Labs., Albuquerque, N. Mex.  
**HELIOS MODEL FOR THE OPTICAL BEHAVIOR OF REFLECTING SOLAR CONCENTRATORS**

F. Biggs and C. N. Vittitoe Mar 1979 324 p refs  
 (Contract EY-76-C-04-0789)

(SAND-76-0347) Avail NTIS HC A14/MF A01

The Helios Model simulates the optical behavior of reflecting concentrators. The model follows the incident solar radiation through the system (including the atmosphere) and includes all the factors that influence the optical performance of a collector. An important output is the flux-density pattern at a grid of points on a surface such as the absorbing surface of a receiver and its integral (power in watts) over the surface. The angular distribution of sunrays for the radiation incident on a concentrator is modified by convolution to incorporate the effects of other nondeterministic factors. The analytical methods used for the statistics, the off-axis reflecting optics, the atmospheric effects and the various coordinate systems are described and illustrated. This model forms a basis for the simulation code HELIOS as well as for other codes under development. Some of the HELIOS routines are described. DOE

**N79-31807#** Market Facts, Inc., Washington, D. C.  
**PASSIVE SOLAR ENERGY FOCUS GROUP RESULTS**

1978 44 p  
 (Contract EV-78-C-01-6458)  
 (DOE/TIC-10016) Avail NTIS HC A03/MF A01

The following are covered: the current state of passive solar energy barriers to the commercialization of passive solar energy; possible actions for surmounting barriers to commercialization; and the role of the Federal Government in commercialization of passive solar energy. Author (DOE)

**N79-31808#** Midwest Research Inst., Golden, Colo.  
**IMPLEMENTATION OF STATE SOLAR INCENTIVES. STATE TESTING AND CERTIFICATION**

Robert Odland Mar 1979 38 p refs  
 (Contract EG-77-C-01-4042)

(SERI/TR-51-162) Avail NTIS HC A03/MF A01

Implementation experiences of four states (Florida, California, Minnesota, and Oregon) with testing and certification programs were examined in order to (1) provide information to other states and local governments that are contemplating adoption and implementation of such programs; (2) provide information to the Federal government for their use in formulating national policies, recognize and accommodate regional diversity. Florida and California have testing and certification programs both currently voluntary although certification in Florida will be required after January 1, 1980, and certification in California may be made a condition of their state income tax credit. Minnesota has a system whereby the characteristics of solar equipment are to be disclosed to the buyer, the manufacturer is charged with developing the necessary information. Oregon has several programs that require qualifying standards or criteria to be developed. One Oregon program requires certification by a state agency. DOE

**N79-31810#** Department of Energy, Washington, D C Office of Energy Research  
**SOCIAL ASSESSMENT OF ON-SITE SOLAR ENERGY TECHNOLOGIES**

Apr 1979 251 p refs  
 (Grant EG-77-G-01-4040)

(HCP/R-4040-02) Avail NTIS HC A12/MF A01

The results of an assessment of the impact of on-site solar energy technology upon society are presented. The assessment utilizes the methodology of social indicators. Twenty-five appropriate social descriptions provide the framework for assessing the technologies of solar space heating and cooling, solar water heating, wind energy conversion, fuelwood and photovoltaics. The report concentrates upon those areas which cause concern as these forms of solar energy realize increasing acceptance and usage by individual citizens. DOE

**N79-31813#** Department of Energy, Washington, D C Office of Conservation and Solar Applications  
**PASSIVE SOLAR ENERGY PLANNING AID KIT FOR BUILDING DESIGN ARCHITECTS AND PLANNERS**

1978 97 p refs Presented at the 2d Natl Passive Solar Conf., Philadelphia, 16 Mar 1978  
 (Contract EM-78-C-01-4228)

(CONF-780337-P1) Avail NTIS HC A05/MF A01

Fourteen articles are presented each containing building design and planning information for passive solar energy application. The articles are organized into three categories: (1) planning and analysis, (2) residential buildings, and (3) office buildings. In a separate section passive design ideas are given along with planning consideration tips. DOE

**N79-31814#** Department of Energy, Washington, D C Office of Conservation and Solar Applications  
**PASSIVE SOLAR ENERGY PLANNING AID KIT FOR THE BUSINESS COMMUNITY AND GENERAL PUBLIC**

1978 124 p Presented at the 2d Natl Passive Solar Conf., Philadelphia, 16 Mar 1978  
 (Contract EM-78-C-01-4228)

(CONF-780337-P2) Avail NTIS HC A06/MF A01

Twenty-three articles are presented each containing information representative of some planning aid aspect of the state of the art in passive solar energy. The articles are organized into four categories: (1) passive solar approach, (2) real buildings in different locations, (3) greenhouses and greenrooms, and (4) design ideas and illustrations. RES

**N79-31815#** Department of Energy, Washington, D C Office of Conservation and Solar Applications  
**PASSIVE SOLAR ENERGY PLANNING AID KIT FOR SOLAR ENERGY SYSTEMS ENGINEERS**

1978 106 p refs Presented at the 2d Natl Passive Solar Conf. Philadelphia, 16 Mar 1978  
 (Contract EM-78-C-01-4228)

(CONF-780337-P3) Avail NTIS HC A06/MF A01

Separate abstracts were prepared for eleven of the included papers. The remaining two papers appeared previously in ERA. Author (DOE)

**N79-31816#** Midwest Research Inst., Golden, Colo  
**GENERATOR GAS. THE SWEDISH EXPERIENCE FROM 1939-1945**

Jan 1979 334 p refs Transl into ENGLISH of the book "Gengas" Stockholm, Swedish Academy of Engineering, 1950 334 p

(Contract EG-77-C-01-4042)

(SERI/SP-33-140) Avail NTIS HC A15/MF A01

The scientific, technical, and commercial information developed during World War 2 when Sweden, cut off from fossil fuels, converted 40% of its entire motor vehicle fleet to burning wood is summarized. Topics discussed include: (1) history, (2) the theory of gas generation, (3) generator gas fuels, (4) shape and design of the gas generator, (5) cooling and cleaning of generator gas, (6) adoption of generator gas for motor operation, (7) adaptation of engines to generator gas for motor operation, (8) gas generator installation, (9) garage and services, (10) practical operating experience, (11) the economics of

generators gas operations, and (12) the hazards of generator gas operation. DOE

**N79-31817#** Department of Energy, Washington, D C  
**THERMAL AND MECHANICAL ENERGY STORAGE PROGRAM**

Mar 1979 184 p

(DOE/ET-0091) Avail NTIS HC A09/MF A01

DOE's Division of Energy Systems is supporting a broad range of projects to conserve energy and to make possible shifting away from oil and natural gas by developing central power generation, dispersed power generating, solar and waste heat utilization, and vehicle propulsion. Categories on mechanical and magnetic energy storage, and chemical/hydrogen energy storage are addressed. DOE

**N79-31818#** Department of Energy, Washington, D C  
**BRIEFING RELATED TO EXECUTIVE ORDER 12003 AND THE NATIONAL ENERGY ACT**

Nov 1978 63 p

(Contract EM-77-C-01-8962)

(DOE/TIC-10065) Avail NTIS HC A04/MF A01

The following briefings are discussed: (1) Managerial Plan Executive Order 12003 and the National Energy Act (NEA), the Plan is outlined and some of the historical background that preceded the presidential issuance of EO 12003 program are covered, (2) Roles and Responsibilities of EO 12003, NEA, and other authorities, (3) impact of the NEA on the Federal Energy Management Program, and (4) proposed interagency Task Group, designated as the Federal Energy Management and Policy Group. Supporting graphics for the briefings are included. DOE

**N79-31819#** Battelle Pacific Northwest Labs., Richland, Wash  
**ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY PRODUCTION**

B W Cone, D L Brencley, and V L Brix Dec 1978 400 p refs

(Contract EY-76-C-06-1830)

(PNL-2410-1-Rev) Avail NTIS HC A17/MF A01

Federal incentives for the development of solar energy are studied and recommendations for the development of a solar energy policy based upon cost incentives for competing energy sources are made. The cost incentives for the other forms of energy are identified and analyzed. Federal incentives to stimulate energy research and development with respect to alternate energy sources are examined. A W H

**N79-31820#** Unified Industries, Inc., Alexandria, Va  
**RECOMMENDED CHANGES TO EXECUTIVE ORDER 12003 AND RELATED AUTHORITIES**

27 Oct 1978 9 p

(Contract EM-77-C-01-8962)

(DOE/TIC-10066) Avail NTIS HC A02/MF A01

Executive Order (EO) 12003, directing that all federal agencies set the example in conservation by upgrading the efficiency of all government buildings and operations so as to achieve sizable energy savings, is discussed. Adjustments to the EO 12003 definition of a building is required to eliminate the need to include leased (new) buildings in the 45 percent energy reduction requirement. Ten changes directed at EO 12003 are presented in a table. DOE

**N79-31821#** Oak Ridge Associated Universities, Tenn Inst for Energy Analysis

**ENERGY POLICY AND MATHEMATICS**

A M Weinburg Mar 1979 22 p refs

(Contract EY-75-C-05-0033)

(ORAU/IEA-79-5(0)) Avail NTIS HC A02/MF A01

Mathematics as it applies to the energy policy and energy policy analysis is discussed. The author suggests that the undecidability of energy estimates of the future may to some degree be finessed by the development of technological options whose feasibility can be established through the help of deterministic mathematics. DOE

**N79-31823#** Unified Industries, Inc., Alexandria Va  
**ANALYSIS AND UPDATE OF ROLES AND RESPONSIBILITIES DERIVED FROM EXECUTIVE ORDER 12003 AND RELATED AUTHORITIES**

31 Oct 1978 51 p refs  
 (Contract EM-77-C-01-8962)

(DOE/TIC-10064) Avail NTIS HC A04/MF A01

All program activities that DOE should perform as part of its management responsibilities for carrying out the President's directive for conserving energy in Federal buildings and operations are identified and analyzed. Activities in which DOE should not become involved are also identified. The basic authorities include the Energy Policy and Conservation Act 381 (1975), Executive Order 11912 (1976), Public Law 95-91 (1977), Executive Order 12003 (1977), and the proposed National Energy Act. A summary of the authorities applicable to the Federal Energy Management Program are given. Based on the analyses, twelve recommendations are presented as strategies for DOE to carry out the initiatives.

DOE

**N79-31824#** Honeywell, Inc. Minneapolis, Minn. Energy Resources Center

**BUILDINGS ENERGY MANAGEMENT PROGRAM WORKSHOP DESIGN Final Report**

Dec 1978 66 p refs

(Contract EM-76-C-01-8630)

(CONS-8630-T1) Avail NTIS HC A04/MF A01

Activities undertaken for design and development of the format, content, and materials that were used in conducting 129 one-day energy management workshops for specific commercial business audiences are described. The Building Energy Management Workshop Program was part of a National Workshop Program that was intended to increase awareness of energy-related issues and to encourage energy-conservation actions on the part of commercial and industrial sectors.

DOE

**N79-31826#** Department of Energy, Washington, D C. Office of Conservation and Solar Applications

**MANAGERIAL PLAN EXECUTIVE ORDER 12003 AND THE NATIONAL ENERGY ACT, PROPOSED, SYNOPSIS**

Sep 1978 18 p refs

(Contract EM-77-C-01-8962)

(DOE/TIC-10062) Avail NTIS HC A02/MF A01

Upgrading the efficiency of all government buildings and operations to achieve sizable energy savings is considered. A managerial plan developed as a basic document to serve the needs of various levels of management is summarized.

DOE

**N79-31827#** Hydrosience, Inc. Knoxville Tenn  
**ASSESSMENT OF LONG-DISTANCE THERMAL-ENERGY TRANSPORT A COMPARISON BETWEEN WATER, STEAM, AND HOT OILS**

Mar 1979 96 p refs

(Contract W-7405-eng-26)

(ORNL/SUB-79/14274/1) Avail NTIS HC A05/MF A01

Capital and operating costs required to supply low to moderate temperature (120 deg to 130 deg) thermal energy via a long distance pipeline system were assessed. Preliminary sizing calculations were performed and basic design requirements were developed. The cases studied involved short (8 km), intermediate (24 km) and long (64 km) transport distances as well as low (273 GJ/hr), intermediate (1370 GJ/hr), and high (4100 GJ/hr) levels of heat input. Thermal energy delivery costs are computed for each case to determine which systems are most economical to construct and operate. Energy outputs were studied for hot water at 1200 C, saturated steam at 177 C, and saturated steam at 249 C.

DOE

**N79-31828#** Exxon Research and Engineering Co. Linden, N J  
**FUEL CELL CATALYST SINTERING STUDIES Final Report**

Y C Pan and G Cipros Jul 1978 104 p refs

(EPRI-EM-833) Avail NTIS HC A03/MF A01

The impact of phosphorous chemistry in controlling the sintering phenomenon in phosphoric acid fuel cells was investigated. Extensive sintering tests were carried out on Pt catalysts

supported on P-100 and other H3PO4 activated carbons from different manufacturers. These tests were conducted at temperatures ranging from 130 C and potentials ranging from +100 mV/SCE to +800 mV/SCE. The results with these supports show good sintering resistance at temperatures below 170 C and potentials up to +700 mV/SCE. At higher temperatures or potentials, such as those representative of FCG-1 operating conditions, the catalysts sintered at measurable rates. However, it was found that the phosphorus content of these spent catalysts had decreased, and furthermore that the Pt crystallite stability was directionally consistent with the phosphorus retention data.

DOE

**N79-31829#** Argonne National Lab., Ill  
**FEASIBILITY OF DISTRICT HEATING OF NORTHERN US CITIES BY COGENERATION**

D J Santini, A A Davis, and S M Marder 1978 19 p refs  
 Presented at 1st Conf on Energy and Community Development, Athens, Greece 10 Jul 1978

(ANL/EES-CP-18, Conf-780744-1)

Avail NTIS

HC A02/MF A01

A study is summarized that examines the engineering and economic feasibility of providing district heating to six major northern US central cities by utilizing cogenerated electrical and thermal energy from retrofit of existing power plants. The four major components of the analysis are discussed, namely: (1) demand estimation, (2) supply analysis, (3) transmission/distribution design, and (4) approximation of operations. A cost comparison to three coal-based heating alternatives is made. In addition to costs, energy savings are illustrated for the district-heating technology. Results indicate that cogeneration-based district heating is a technology worthy of continued evaluating by the US.

DOE

**N79-31830#** Argonne National Lab., Ill  
**APPLICATION OF AIR EJECTORS TO THE PERFORMANCE IMPROVEMENT AND COST REDUCTION OF COMPRESSED AIR STORAGE POWER PLANTS**

F W Ahrens, T T Ng, and D R Otis 1978 27 p refs  
 Presented at CAES Technol Symp., Pacific Grove, Calif 15 May 1978

(Contract W-31-109-eng-38)

(CONF-780599-1) Avail NTIS HC A03/MF A01

Ways in which air ejectors could be integrated into compressed air energy storage (CAES) power systems in order to achieve a reduction in costly air storage volume and a possible savings in air compression work are explored. Primary emphasis is given to a scheme involving multiple constant-volume caverns with the pumping effect of the air ejector replacing the wasteful throttling process. The results cover a range of ejector efficiency and CAES system design conditions. It appears that volume reductions of 20 to 30% or more and compression work savings of 2 to 4% can be achieved.

DOE

**N79-31831#** Gulf Universities Research Consortium, Bellaire, Tex

**REQUIREMENTS FOR THE DEVELOPMENT, MANAGEMENT AND IMPLEMENTATION OF RESEARCH IN SUPPORT OF THE DEPARTMENT OF ENERGY ENHANCED OIL RECOVERY PROGRAM**

C R Hocott and R H Maier Feb 1979 114 p

(Contract EX-76-C-01-2025)

(BETC-2025-1, GURC-163A) Avail NTIS HC A06/MF A01

Recommendations concerning a supplemental research program for enhanced oil recovery (EOR) are outlined. A program of studies to identify, describe, and quantify geologic and geochemical factors which have a major influence on EOR processes should be initiated. The interactions within EOR systems and the interactions between fluid system components and rocks and fluids in the reservoir environment should be studied as a unified program. Dialogue and exchange of data and materials between laboratory investigations and field tests should be promoted and for some projects should be a requirement. Research programs which are not as developed as the surfactant-polymer program should be expanded. Comprehensive systems and procedures must be adopted soon for the collection, analysis

filing dissemination and interchange of data being developed in the different program sections DOE

**N79-31832#** Boeing Engineering and Construction, Seattle, Wash

**CENTRAL RECEIVER DESIGN CONSIDERATIONS FOR BRAYTON CYCLE SOLAR POWER PLANTS**

J R Gintz and R C Zentner 1978 21 p refs Presented at Symp on Solar-Thermal Power Stations, Cologne West Ger, 12 Apr 1978 Prepared for EPRI (EPRI Proj RP-377-1)

(AED-Conf-78-212-016, Conf-780425-13) Avail NTIS (US Sales Only) HC A02/MF A01, DOE Depository Libraries

A central solar power plant utilizing gas turbine machinery for the power conversion cycle is described The design requirements, design rationale, thermal performance, and technical feasibility of the receiver system are discussed The cavity receiver concept and initial receiver configurations are examined Candidate materials to satisfy the design requirements for a commercial sized receiver are evaluated DOE

**N79-31836#** National Technical Information Service, Springfield, Va

**WIND POWER, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - Apr 1979**

Audrey S Hundemann Jun 1979 282 p Supersedes NTIS/PS-78/0416, NTIS/PS-77/0399, NTIS/PS-76/0358, NTIS/PS-75/348, COM-74-11103

(NTIS/PS-79/0534/2, NTIS/PS-78/0416, NTIS/PS-77/0399, NTIS/PS-76/0358, NTIS/PS-75/348, COM-74-11103) Avail NTIS HC \$28 00/MF \$28 00 CSDL 108

This bibliography contains 276 citations on the feasibility, use, and engineering aspects of wind power and windmills The use of wind power for electric power generation and wind turbine design and performance is examined Comparative analyses of wind power and alternative energy sources are included, as are energy storage devices which can be used in these systems GRA

**N79-31837#** National Technical Information Service, Springfield, Va

**WIND POWER, VOLUME 1 CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - 1977**

Audrey S Hundemann Jun 1979 225 p (NTIS/PS-79/0535/9) Avail NTIS HC \$28 00/MF \$28 00 CSDL 108

This bibliography contains 210 citations on windmill and wind power feasibility, use, and engineering The use of wind power for electric power generation and wind turbine design and performance is reported The use of wind power in developing countries and comparative analyses of wind power and alternative energy sources are included, as are studies on energy storage systems GRA

**N79-31838#** National Technical Information Service, Springfield, Va

**WIND POWER, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1978 - Apr 1979**

Audrey S Hundemann Jun 1979 131 p Supersedes NTIS/PS-78/0417, NTIS/PS-77/0400 NTIS/PS-76/0359 (NTIS/PS-79/0536/7, NTIS/PS-78/0417, NTIS/PS-77/0400, NTIS/PS-76/0359) Avail NTIS HC \$28 00/MF \$28 00 CSDL 108

Windmill and wind power feasibility use, and engineering are discussed in these citations of world-wide research Abstracts primarily cover the use of wind power for electric power generation and wind turbine design and performance General studies dealing with the use of wind power in developing countries and comparative analyses of wind power and alternative energy sources are included, as are studies on energy storage systems This updated bibliography contains 125 abstracts 113 of which are new entries to the previous edition GRA

**N79-31839#** National Aeronautics and Space Administration Langley Research Center Hampton, Va

**REMOTE MONITORING OF THE GRAVELLY RUN THERMAL PLUME AT HOPEWELL AND THE THERMAL PLUME AT THE SURRY NUCLEAR POWER PLANT ON THE JAMES RIVER**

T A Talay, K W Sykes (Army Corps of Engineers Norfolk Va), and C Y Kuo (Virginia Polytechnic Inst and State Univ, Blacksburg) Jul 1979 21 p refs Presented at the Virginia Academy of Science, 56th Ann Meeting, Blacksburg, 9-12 May 1978

(NASA-TM-80124) Avail NTIS HC A02/MF A01 CSDL 138

On May 17, 1977 a remote sensing experiment was conducted on the James River Virginia, whereby thermal spectrometer and near-infrared photography data of thermal discharges at Hopewell and the Surry nuclear power plant were obtained by an aircraft for one tidal cycle These data were used in subsequent investigations into the near field discharge trajectories For the Gravelly Run thermal plume at Hopewell, several empirical expressions for the plume centerline were evaluated by comparisons of the computed trajectories and those observed in the remote sensing images Author

**N79-31844#** Mitre Corp., McLean, Va

**NATIONAL ENVIRONMENTAL IMPACT PROJECTION NO. 1**

Richard J Kalaagher, Beth L Borko, Deborah Elcock, Robert Kline, Andy Lawrence, Nazir Dossani Alan D Bernstein, Thomas H Piwowar, William P Weygandt and Marc Narkus-Kramer Feb 1979 107 p refs Prepared in cooperation with CONSAD Res Corp, Pittsburgh, Pa, Intern Res and Technol Corp McLean Va, and Control Data Corp, Minneapolis, Minn (Contract E-77-C-01-6119)

(HCP/P-6119) Avail NTIS HC A06/MF A01

Environmental and economic impacts expected to result under the Energy Information Administration's energy supply and demand projections to 1990 are presented DOE

**N79-31845#** Washington Univ Seattle Center for Quantitative Science in Forestry, Fisheries, and Wildlife

**ASSESSING THE IMPACT OF NUCLEAR-POWER PLANTS ON THE ENVIRONMENT Annual Progress Report**

D G Chapman, D P Lettenmaier, A H Seymour, G L Swartzman and H E Lawson Dec 1978 179 p refs (NUREG/CR-0552, APR-2) Avail NTIS HC A09/MF A01

An assessment of the wide-ranging effects that nuclear power plants can have on the environment is presented The effects include mortality to fish and other organisms resulting from impingement and entrainment in the cooling system, changes in behavioral and physiological characteristics of aquatic animals by higher temperatures present in the discharge plume, and toxic effects of biocides, heavy metals and radionuclides released in the aquatic or atmospheric environment DOE

**N79-32075#** Atomics International Div Richland Wash Rockwell Hanford Operations

**SPENT FUEL HANDLING AND PACKAGING PROGRAM**

Sep 1978 24 p refs

(Contract EY-77-C-06-1030)

(RHO-LD-78-4-SEP) Avail NTIS HC A02/MF A01

The objective is to design, develop and demonstrate a spent fuel package for geologic storage and disposal, to design license and construct the facilities to produce this package and to develop and demonstrate technology for the dry passive surface storage of spent fuel Progress is reported on engineering and system studies technical R and D studies, demonstrations project support studies, spent fuel facility project and program management DOE

**N79-32081#** Atomics International Div Richland, Wash Rockwell Hanford Operations

**SPENT FUEL HANDLING AND PACKAGING PROGRAM Management Summary Report, Aug 1978**

Dec 1978 23 p



(Contract EY-77-C-06-1030)

(RHO-LD-78-4-AUG) Avail NTIS HC A02/MF A01

The program has the objective to design, develop, and demonstrate a spent fuel package for geologic storage and disposal and design, license, and construct the facilities to produce this package, and to develop and demonstrate technology for the dry, passive surface storage of spent fuel. A 90% complete draft of the Spent Fuel Receiving and Packaging Facility conceptual design report was completed. The construction work at the Nevada Test Site, in support of the 1978 Spent Fuel Demonstration was restarted. DOE

**N79-32113#** Oak Ridge National Lab., Tenn**OPTIMIZATION OF THE FISSION-FUSION HYBRID CONCEPT**

M J Saltmarsh, W R Grimes, and R T Santoro Apr 1979 56 p refs

(Contract W-7405-eng-26)

(ORNL/PPA-79/3) Avail NTIS HC A04/MF A01

The role of the fission-fusion hybrid reactor as a fissile fuel producer is discussed. The advantages of the concept in terms of the performance of the fusion device and the breeding blankets are presented. Some of the troublesome features of existing design studies are described. Hybrids based on deuterium-tritium (D-T) fusion devices are unlikely to be economically attractive and present formidable blanket technology problems. An alternative approach based on a semicatalyzed deuterium-deuterium fusion reactor and a molten salt blanket is discussed. This concept is shown to emphasize the desirable features of the hybrid, to have considerably greater economic potential, and to mitigate many of the disadvantages of D-T-based systems. DOE

**N79-32129#** Detroit Diesel Allison, Indianapolis, Ind**SINGLE SHAFT AUTOMOTIVE GAS TURBINE ENGINE CHARACTERIZATION TEST Final Report**

R A Johnson Sep 1979 103 p Prepared for NASA and DOE

(Contracts DEN3-4, EC-77-A-31-1040)

(NASA-CR-159654, DDA-EDR-9790, DOE/NASA/0004-79/1)

Avail NTIS HC A06/MF A01 CSCL 13F

An automotive gas turbine incorporating a single stage centrifugal compressor and a single stage radial inflow turbine is described. Among the engine's features is the use of wide range variable geometry at the inlet guide vanes, the compressor diffuser vanes, and the turbine inlet vanes to achieve improved part load fuel economy. The engine was tested to determine its performance in both the variable geometry and equivalent fixed geometry modes. Testing was conducted without the originally designed recuperator. Test results were compared with the predicted performance of the nonrecuperative engine based on existing component rig test maps. Agreement between test results and the computer model was achieved. AWH

**N79-32130#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**THREE STATE-OF-THE-ART INDIVIDUAL ELECTRIC AND HYBRID VEHICLE TEST REPORTS, VOLUME 2**

Nov 1978 329 p refs

(Contract EC-77-A-31-1011)

(NASA-CR-162311, HCP/M1011-03/2-Vol-2) Avail NTIS HC A15/MF A01

Procedures used in determining the energy efficiency and economy of a gasoline-electric hybrid taxi, an electric passenger car, and an electric van are described. Tabular and graphic data show results of driving cycle and constant speed tests, energy distribution to various components, efficiency of the components, and, for the hybrid vehicle, the emissions. ARH

**N79-32131#** Sandia Labs., Albuquerque, N Mex**PROBLEMS OF TECHNOLOGY TRANSFER TO INDUSTRY**

1979 15 p refs Presented at the 6th Energy Technol Conf and Exposition, Washington, D C, 26 Feb 1979

(Contract EY-76-C-04-0789)

(SAND-79-0096, Conf-790213-1)

Avail NTIS HC A02/MF A01

The following are discussed: solar energy utilization, technology development, technology transfer, and problems with

technology transfer. Examples of technology development and transfer to industry are given. DOE

**N79-32135#** Dynamic Science, Phoenix, Ariz**PARATRANSIT VEHICLE TEST AND EVALUATION, VOLUME 4: FUEL ECONOMY TESTS Final Report, Nov. 1978 - Jul 1977**

L Wesson, C Culley, and R L Anderson Jun 1978 51 p

5 Vol

(Contract DOT-TSC-1241)

(PB-295478/2, UMTA-MA-06-0052-78-4,

DOT-TSC-UMTA-77-49-4) Avail NTIS HC A04/MF A01, also available in set of 5 reports HC E14 as PB-295474-SET CSCL 13F

A series of tests and evaluations of two prototype vehicles for paratransit were conducted. The test procedures and results of the fuel economy tests are presented. The test series determined the fuel economy of the vehicles as they were driven through simulated urban and suburban driving cycles. The relationships between fuel consumption and vehicle speeds were determined and maximum fuel economies were established. GRA

**N79-32237#** Michigan Univ., Ann Arbor Dept of Aeronautical Engineering**EXTRATERRESTRIAL FIBERGLASS PRODUCTION USING SOLAR ENERGY**

Darwin Ho and Leon E Sobon /in NASA Ames Res Center Space Resources and Space Settlements 1979 p 225-232 refs

Avail NTIS MF A01, SOD HC CSCL 22A

A conceptual design is presented for fiberglass production systems in both lunar and space environments. The raw material, of lunar origin, will be plagioclase concentrate, high silica content slag, and calcium oxide. Glass will be melted by solar energy. The multifurnace in the lunar plant and the spinning cylinder in the space plant are unique design features. Furnace design appears to be the most critical element in optimizing system performance. A conservative estimate of the total power generated by solar concentrators is 1880 kW, the mass of both plants is 120 tons. The systems will reproduce about 90 times their total mass in fiberglass in 1 year. A new design concept would be necessary if glass rods were produced in space. Author

**N79-32372#** Department of Energy, Washington, D C Information Administration**ROLE OF REFINED PRODUCT IMPORTS IN THE DOMESTIC FUEL MARKET**

M J Frederiksen Apr 1979 64 p refs

(DOE/EIA-0102/53) Avail NTIS HC A04/MF A01

The effects of domestic petroleum regulations on refined product prices in the United States and on the tradeoff between the levels of domestic refinery production and refined product imports were analyzed. (1) the crude oil cost advantage which domestic refiners enjoy because of crude oil price controls decreased by 50 percent since March 1976, (2) at least some of the resulting increase in crude oil acquisition cost was passed through into gasoline and distillate prices, (3) in the East Coast residual fuel oil market, imports have increased substantially since 1976, and the increase may have prevented the passthrough of crude oil cost increases, (4) the crude oil cost advantage and the small refiner bias in the entitlements program have caused greater domestic refinery production and lower utilization of foreign refining capacity than would have occurred without the regulations, and (5) deregulation of crude oil prices is likely to result in some increase in refined product prices. DOE

**N79-32373#** Sandia Labs., Albuquerque, N Mex**FUELS FROM MAGMA: A POTENTIAL ENERGY SOURCE**

T M Gerlach 1978 8 p refs Presented at the 2d Circum-Pacific Energy and Mineral Resources Conf., Honolulu 30 Jul 1978

(Contract EY-76-C-04-0789)

(SAND-78-0191, Conf-780737-1)

Avail NTIS HC A02/MF A01

The chemical and thermodynamic basis, the confirmatory laboratory experiments, and the geological data that point to

the potential of magma as a resource that could produce large amounts of hydrogen as well as carbon monoxide and methane are discussed. The method of fuel production proposed depends on the reducing action of basalt on injected water; this chemical interaction causes the oxidation of ferrous components in the basalt and the production of hydrogen. The amount of hydrogen produced by a given body of basalt can be enhanced by introducing natural organic matter (biomass) into the injected water. This also would permit the method to be used to produce appreciable quantities of carbon monoxide and methane, and allows the exploitation of less FeO-rich magmas and hot rocks. Calculations show that the thermal energy of the magma may be used to gasify the biomass with resultant gas species resembling those from more conventional coal gasification processes. DOE

**N79-32374#** Midwest Research Inst., Golden Colo. Solar Energy Research Inst.

**REVIEW OF CURRENT RESEARCH ON HYDROCARBON PRODUCTION BY PLANTS**

H. M. Benedict and B. Inman. Jan 1979. 38 p. refs.

(Contract EG-77-C-01-4042)

(SERI/TR-33-129) Avail NTIS HC A03/MF A01

Except in the case of guayule (*Parthenium argentatum* Gray), research on hydrocarbon species generally has not advanced beyond preliminary screening, extraction, and growth studies. Virtually no field studies have been initiated; hydrocarbon component extraction, separation, identification, and characterization have been only timidly approached; the biochemistry of hydrocarbon formation remains virtually untouched, and potential market analysis has been based on insufficient data. Due to the infant state of technology in this area of energy research, it is not possible to predict or satisfactorily assess at this time the potential contribution that plant hydrocarbons might make toward decreasing the nation's dependence upon petroleum. However, the general impression received from experts interviewed during this review was that the major thrust of research should be directed toward the manufacture of petrochemical substitutes rather than fuel production. DOE

**N79-32375#** Department of Energy, Laramie, Wyo. Energy Technology Center

**MATHEMATICAL MODEL OF FORWARD COMBUSTION RETORTING OF OIL SHALE**

L. Dockter and H. G. Harris. Jul 1978. 24 p. refs.

(Contract EX-76-S-01-2234)

(LETCT/TPR-78/1) Avail NTIS HC A02/MF A01

The first version or base model is described of a mathematical model of vertical forward combustion retorting of oil shale that was developed through 1974 at the Laramie Energy Technology Center in Laramie, Wyoming. The model was written to simulate conditions and processes occurring in LETC's experimental batch-type 150-ton retort. Information presented deals with the reasoning and justification for developing the model, a description of the modeling effort, and a comparison of the yields, retorting rates, and other information obtained from the model as compared with actual results from the 150-ton retort. Good qualitative agreement between the base model and actual experimental results is found. However, quantitative agreement is not realized in this version of the model; some reasons for this are discussed. DOE

**N79-32379#** Marquette Univ., Milwaukee, Wis.  
**THERMODYNAMIC-ECONOMIC ANALYSIS OF THE SYNTHANE PROCESS**

R. Gaggioli, L. Rodriguez, and W. Wepfer. Nov 1978. 104 p. refs.

(Contract EY-77-S-02-4589)

(COO-4589-1) Avail NTIS HC A06/MF A01

An exhaustive Second Law analysis of the synthane process is presented, including an efficiency and a costing study, both based on the available energy concept. The analysis shows an overall process efficiency of 46%. For 100 kwhr of useful energy supplied with coal, 51 kwhr are consumed driving the various unit operations while effluents carry 3 kwhr. The conceptual design of units clearly leads to inordinately high costs for utilities

(steam power oxygen) compared to common utility costs readily attainable even with more expensive fuels. A preliminary recosting assuming reasonable (yet conservatively high) costs of utility production, showed that product gas cost would be reduced from 2.1 cents/kwhr to 1.7 cents/kwhr, readily. DOE

**N79-32382#** Braun (C. F.) and Co., Alhambra, Calif.

**FIXED BED METHANATION PROCESSES. Final Report**

V. P. Sirohi. Aug 1978. 36 p. refs.

(Contract EX-76-C-01-2240)

(FE-2240-96) Avail NTIS HC A03/MF A01

Based on the economic comparison of this study, it was concluded that the process arrangement of Hot Gas Recycle is economically attractive because it allows a maximum steam production at high pressure. The use of a high temperature catalyst results in a more economical process design in comparison with a low temperature catalyst. This is due to the increase in temperature rise across the methanator reactors, which in turn reduces the recycle flow rate, catalyst requirements, and vessel sizes. More efficient heat recovery is also obtained. It is also concluded that the three reactor system is more economical than a single reactor methanation process. The use of the Hot Gas Recycle with three reactors is recommended for all types of methanation catalysts. A high temperature catalyst has a further economic advantage over other catalysts. It is recommended that such a catalyst be demonstrated commercially to confirm its potential. DOE

**N79-32383#** Oak Ridge National Lab., Tenn.

**RECENT DEVELOPMENTS IN COAL LIQUEFACTION IN THE UNITED STATES**

L. E. McNeese, L. E. Salmon, and H. D. Cochran Jr. 26 Feb 1979. 38 p. refs. Presented at 6th Energy Technol. Conf. and Exposition, Washington, D. C. 26 Feb 1979.

(Contract W-7405-eng-26)

(CONF-790213-5) Avail NTIS HC A03/MF A01

The mechanisms by which the synthetic fuels industry developed were considered. It is not at all clear that natural marketplace forces are able to build the industry rapidly enough to meet the demands expected in the next 20 to 30 years. The need for government initiative was widely discussed. The need for careful consideration of the demand-time curve for synthetic liquid fuels and of the length of time required to build an industry of the size needed was emphasized. DOE

**N79-32384#** SRI International Corp., Menlo Park, Calif.

**MISSION ANALYSIS FOR THE FEDERAL FUELS FROM BIOMASS PROGRAM. VOLUME 4. THERMOCHEMICAL CONVERSION OF BIOMASS TO FUELS AND CHEMICALS. Final Report**

S. M. Kohan and P. M. Barkhordar. Jan 1979. 179 p. refs. (SAN-0115-T3) Avail NTIS HC A09/MF A01

The selection of the feedstock used in the analysis of thermochemical conversion technologies is discussed. Detailed technical and economic evaluation are presented of biomass conversion to electricity and steam by combustion, SNG by gasification, and methanol by gasification and synthesis, oil by catalytic liquefaction, oil and char by pyrolysis, and ammonia by gasification and synthesis. DOE

**N79-32385#** SRI International Corp., Menlo Park, Calif.

**MISSION ANALYSIS FOR THE FEDERAL FUELS FROM BIOMASS PROGRAM. VOLUME 1. SUMMARY AND CONCLUSIONS. Final Report, Dec 1978**

F. A. Schooley, R. L. Dickenson, S. M. Kohan, and J. L. Jones. Mar 1979. 76 p. refs.

(Contract EY-76-C-03-0115-131)

(SAN-0115-T2) Avail NTIS HC A05/MF A01

An overview report on biomass derived fuels likely to achieve future market penetration and commercialization for the DOE Solar Energy Division, Fuels From Biomass System Branch is presented. Fifteen feedstock-to-product routes were studied in detail, and economic data were summarized for 53 missions. Using a market penetration model and assuming base case feedstock availability (without federal incentives), it was deter-

mined that seven of the 53 missions studied penetrate the market in 1985 15 missions penetrate in 2000 and 15 penetrate in 2020 producing about 0.7 3.5 and 5.4 quadrillion Btu of useful fuel products respectively in each of the years DOE

**N79-32386#** Pittsburgh Univ Pa  
**SCREENING OF ZEOLITE CATALYSTS FOR METHANOL CONVERSION TO LIGHT HYDROCARBONS** Final Report, 1 Jan - 30 Sep 1978

J T Cobb, Jr V T Coon and P Tipnis Sep 1978 38 p refs

(Contract EW-78-S-02-4691)

(COO-4691-1) Avail NTIS HC A03/MF A01

Eleven tests were performed with Zeolon 500 (chabazite) and lanthanum-exchanged Zeolon 500 During the first 300 to 800 minutes of each test, catalyst performance was examined The independent variables explored were extent of lanthanum exchange temperature space velocity, and short-term aging Selectivity was greatly affected by aging with paraffins being the major product in the first few minutes, olefins being present at intermediate times, and dimethyl ether being the major product toward the end of the study period in each test At higher temperatures, the rate of aging decreased the maximum olefins produced increased and the production of dimethyl ether decreased Eleven catalyst samples were analyzed for carbon content by standard techniques and for structural features by powder X-ray diffraction Aged samples contained about 10% carbon Fresh samples and samples regenerated once showed 0.1% carbon and similar X-ray patterns DOE

**N79-32387#** Brookhaven National Lab, Upton N Y  
**METAL HYDRIDE TECHNOLOGY**

J J Reilly Feb 1979 60 p Presented at Hydrogen in Metals Intern Meeting, Munster, W Ger, 6 Mar 1979

(Contract EY-76-C-02-0016)

(BNL-26047, Conf-790301-10)

Avail NTIS

HC A04/MF A01

The properties and applications of systems which have proven of potential utility as hydrogen storage compounds are summarized Specific systems discussed are magnesium alloy hydrides iron-titanium alloys titanium-chromium alloys and rare earth alloys DOE

**N79-32388#** Brookhaven National Lab Upton, N Y  
**ADVANCED SYN-FUEL PRODUCTION WITH FUSION**

J R Powell and J A Fillo 1979 8 p refs Presented at 14th Intersoc Energy Conversion Conf, Boston, 5 Aug 1979 (Contract EY-76-C-02-0016)

(BNL-26130, Conf-790803-26)

Avail NTIS

HC A02/MF A01

An important first step in the synthesis of liquid and gaseous fuels is the production of hydrogen Thermonuclear fusion offers a nearly inexhaustible source of energy for the production of hydrogen from water Depending on design, electric generation efficiencies of approximately 40 to 60% and hydrogen production efficiencies by high temperature electrolysis of approximately 50 to 70% are projected for fusion reactors using high temperature blankets DOE

**N79-32390#** TRW, Inc, McLean Va Energy Systems Planning Div

**METHANE RECOVERY FROM COALBEDS PROJECT TECHNOLOGY TEST PROJECTS EVALUATION OF CANDIDATE PROJECTS**

Feb 1979 26 p

(Contract EW-78-C-21-8089)

(DOE/TIC-10128) Avail NTIS HC A03/MF A01

Of twelve candidate methane recovery projects evaluated, eight have sufficient information for a fair ranking Three of the other four had concepts which did not offer any features not found in the eight ranked projects The four projects recommended for further pursuit were selected on the basis of potential technology gains economics, transferability of generated data and on the potential for evolving widely used concepts The selected projects are (1) Occidental Research/Island Creek Coal - horizontal boreholes in advance of mining, (2) Bethlehem Mines - vertical wells in advance of mining (3) Waynesburg

College - multiple completion technology project and (4) Pennsylvania Energy Resources - multiple completion multiple wells in anthracite The major features of these projects are described DOE

**N79-32391#** Institute of Gas Technology Chicago Ill  
**PEAT GASIFICATION AN EXPERIMENTAL STUDY**

D V Punwani, S P Nandi L W Gavin and J L Johnson 1978 34 p refs Presented at the 85th Natl Meeting of the Am Inst of Chem Engr Philadelphia 4-8 Jun 1978

(Contract EX-76-C-01-2469)

(CONF-780611-8) Avail NTIS HC A03/MF A01

Compared to lignite, peat is several times more reactive and makes four times as much light hydrocarbon gases during initial short-residence-time (5 seconds) hydrogasification Compared to coal (at temperatures above 1440 F) hydrogen pressures above 4 atmospheres are relatively less essential for increasing light hydrocarbon gas yields On an overall basis, peat is an exceptionally good raw material for SNG production Based on the experimental results, a conceptual commercial reactor configuration was selected which incorporates a dilute-phase cocurrent, short-residence-time hydrogasification stage followed by fluidized-bed char gasification with steam and oxygen Tests in process development units are in progress DOE

**N79-32393#** Rheinische Braunkohlenwerke A G Cologne (West Germany) Abt Forschung und Entwicklung

**RESEARCH AND DEVELOPMENT WORK FOR HYDROGASIFICATION OF COAL WITH NUCLEAR PROCESSING HEAT DONE IN THE FRAMEWORK OF THE PROTOTYPE NUCLEAR PROCESSING HEATER PROJECT** Final Report

Lothar Schrader Bonn Bundesmin fuer Forsch u Technol Nov 1978 120 p refs In GERMAN, ENGLISH summary

(Contract BMFT-PL-ET-1399-C)

(BMFT-FB-T-78-25) Avail NTIS HC A06/MF A01 Fachinformationszentrum Eggenstein-Leopoldshafen, West Germany DM 25.20

A technique for coal gasification using nuclear processing heat was developed, then studied following the construction of a pilot plant for hydrogasification in a fluidized bed with an input of 100 kg coal/hr This process for the production of synthetic natural gas or carbon monoxide and hydrogen gas containing mixtures is shown to have the advantages of saving feed coal improving efficiency, reducing emissions and stabilizing energy costs The design construction and operation of the pilot plant are described Components have been proven for the hydrogasification of brown coal and rock coal Results demonstrate the suitability of this unit as a part of a large scale gasification plant Author (ESA)

**N79-32394#** Bergbau-Forschung G m b H, Essen (West Germany) Abt Physikalische Chemie

**RESEARCH AND DEVELOPMENT CONCERNING STEAM GASIFICATION OF COAL REPORT ON THE CONCEPT OF A PROTOTYPE PLANT USING NUCLEAR PROCESSING HEAT** Final Report

Karl-Heinrich vanHeek Bonn Bundesmin fuer Forsch u Technol Dec 1978 93 p refs In GERMAN, ENGLISH summary

(Contract BMFT-03E-1399-A/ETS-0004-1)

(BMFT-FB-T-78-29) Avail NTIS HC A05/MF A01, Fachinformationszentrum, Eggenstein-Leopoldshafen, West Germany DM 19.35

The development of a coal gasification process using a high temperature nuclear reactor to meet the energy requirements of the process is described A key point in the development is the gas generator in which the nuclear heat is transferred into a fluidized bed of coal and steam via an intermediate loop and a heat exchanger immersed in the bed On the basis of former results concerning reaction kinetics and heat transfer, further experiments with different devices were performed and the program for the testing and the development of new alloys to be used was continued A pilot plant (0.2 T/hr) using an electrically heated helium loop was constructed and is now in operation The data gathered confirm the feasibility of the gas generator as well as the process and are being used for the design of bigger plants Author (ESA)

**N79-32477#** Los Alamos Scientific Lab , N Mex  
**THERMOELASTIC ANALYSIS OF A SUPERCONDUCTING CABLE**

P D Smith Sep 1978 24 p refs  
 (Contract W-7405-eng-36)  
 (LA-7465-MS) Avail NTIS HC A02/MF A01

The thermoelastic response of a superconducting power transmission cable when it is chilled from ambient to operating temperature is described. The cable consists of coaxial stranded conductors separated with a cylindrical dielectric. Cable end reactions and internal stresses are determined. Sample results for a hypothetical cable indicate that cable end reactions and peak stresses in the strands are sensitive to the initial helix angles and initial helix radii of the conductor strands. DOE

**N79-32481#** Los Alamos Scientific Lab , N Mex  
**ENERGY LOSSES IN A FLAT TRANPOSED CABLE**

Bernard Turck Feb 1979 13 p refs  
 (Contract W-7405-ENG-36)  
 (LA-7635-MS) Avail NTIS HC A02/MF A01

Extra energy losses caused by the coupling currents between strands in a flat superconducting cable that is exposed to an external changing field are derived. Special attention is given to the cable with an insulating strap interposed between the two layers of strands so as to reduce the losses. It is shown that the losses are not reduced as much as expected. DOE

**N79-32515#** Oak Ridge National Lab , Tenn  
**CONDENSATION OF REFRIGERANTS ON VERTICAL FLUTED TUBES**

S K Combs, G S Mailen, and R W Murphy Aug 1978 203 p refs  
 (Contract W-7405-eng-26)  
 (ORNL/TM-5848) Avail NTIS HC A10/MF A01

Experiments were run to determine heat transfer performance of single vertical fluted tubes with selected fluids condensing on the outside. Working fluids included six fluorocarbons (Refrigerants 11, 21, 22, 113, 114, and 115) and a hydrocarbon (Refrigerant 600a or isobutane). The nine test tubes were of 2.54-cm nominal outside diameter and 1.2 m in length with from 0 (smooth) to 60 axial flutes. Condensing heat transfer coefficients ranged from 620 to 7900 W/sq m K over the heat flux range of 2000 to 43,000 W/sq m. All parameters are based on total condensing surface area. The data show that, for a given heat flux, a fluted tube can increase condensing coefficients up to 6.0 times smooth tube values. Further heat transfer enhancement was achieved by the use of drainage skirts on fluted tubes; these skirts effectively divided the 1.2-m tubes into two, four, and eight equal condensing lengths. DOE

**N79-32516#** Stanford Univ , Calif Petroleum Research Inst  
**TRANSIENT FLOW OF NON-NEWTONIAN POWER-LAW FLUIDS IN POROUS MEDIA Ph.D. Thesis**

C U Ikoku and H J Ramey Jr Feb 1979 271 p refs  
 (Contract EY-76-C-03-1265)  
 (SAN-1265-9, SU-SUPRI-TR-9) Avail NTIS HC A12/MF A01

The basic characteristics of transient injection of a power-law non-Newtonian fluid were studied. A nonlinear partial differential equation for flow of power-law fluids was derived. The diffusivity equation is a special case of this equation. The partial differential equation describes the flow of a slightly compressible, non-Newtonian power-law fluid in a homogeneous and isotropic porous medium. This equation should govern the flow of most agents used in enhanced oil recovery projects. A linear form of the partial differential equation was also derived. A model for the flow of foam in porous media gave rise to another nonlinear partial differential equation which considers the compressibility of foam, and the pressure-dependent quality of foam. Analytical solutions of the transient and steady state forms of the linear partial differential equation were obtained. DOE

**N79-32518#** Los Alamos Scientific Lab , N Mex  
**CERAMIC HEAT PIPES FOR HIGH TEMPERATURE HEAT REMOVAL**

E S Keddy and W A Ranken 1978 17 p refs Presented at the 18th Natl Heat Transfer Conf (AIChE-ASME), San Diego,

Calif , 5-8 Aug 1978  
 (Contract W-7405-ENG-36)  
 (LA-UR-79-332, Conf-7808101-1) Avail NTIS HC A02/MF A01

A development program was initiated to demonstrate the technical and eventually the economical feasibility of ceramic heat pipes and ceramic heat pipe recuperators. The prime candidate for heat pipe construction is SiC. Closed-end tubes of this material were prepared by chemical vapor deposition (CVD). These tubes were lined internally with tungsten by a subsequent CVD operation, partially filled with sodium, and sealed by brazing a tungsten lined SiC plug into the open end with a palladium-cobalt alloy. Heat pipes constructed in this manner were successfully operated in vacuum at temperatures of 1225 K and in air at a temperature of 1125 K. The heat source used initially for the air testing was an induction heated metallic sleeve in thermal contact with the test unit. Subsequent testing has shown that a silicon carbide heat pipe can be successfully operated with natural gas burners providing the input heat. Methods of fabricating and testing these devices are described. DOE

**N79-32555#** Oak Ridge National Lab , Tenn  
**FREQUENCY ANALYSIS OF A THICK-RIM FLYWHEEL**

D N Fanning Sep 1978 50 p refs  
 (Contract W-7405-eng-26)  
 (ORNL/TM-5804) Avail NTIS HC A03/MF A01

The calculation of natural frequencies of a thick rim flywheel is presented using two analysis methods: the finite element method and the transfer matrix method. A listing of the computer program developed using the transfer matrix method is included. The results of the finite element analysis indicate that the computer programs NONSAP and ADINA are incapable of determining out-of-plane natural frequencies of the flywheel. The results of the analysis using the transfer matrix method are satisfactory for out-of-plane as well as in-plane frequencies. DOE

**N79-32617#** Department of Energy, Washington, D C Office of Strategic Petroleum Reserve  
**STRATEGIC PETROLEUM RESERVE Annual Report**

16 Feb 1979 89 p Sponsored by DOE  
 (DOE/TIC-10107 AR-2) Avail NTIS HC A05/MF A01

Reserve development activities during 1978 are reported. Status of the 9 sites is discussed in appendixes. DOE

**N79-32618#** Department of Energy, Washington, D C Energy Information Administration  
**REEXAMINATION OF THE ESTIMATION OF UNDISCOVERED OIL RESOURCES IN THE US**

N Uri Apr 1979 23 p refs  
 (DOE/EIA-0103/31, TM/ES/79-03) Avail NTIS HC A02/MF A01

The estimation of total producible oil in the United States is discussed. Two specific models, a logistic model and a Gompertz model, are suggested and estimated in a fashion consistent with the theoretical considerations. The results indicate that approximately 159 billion barrels are ultimately recoverable and producible of which 117 billion barrels have been produced through the end of 1978. DOE

**N79-32619#** Department of Energy, Washington, D C Information Administration  
**ASSESSMENT OF POTENTIAL US PETROLEUM SUPPLY SHORTFALLS, 1978 - 1980**

D Butler 15 Sep 1978 40 p refs  
 (DOE/EIA-0102/13) Avail NTIS HC A03/MF A01

The 1977 Energy Information Administration projection series was modified to reflect the likelihood of constrained world oil supplies in the 1980's and the associated increases in oil prices required to balance world supply and demand. DOE

**N79-32620#** Argonne National Lab , Ill Energy and Environmental Systems Div

**MICELLAR/POLYMER FLOODS FOR ENHANCED OIL RECOVERY: A REVIEW OF DISPLACEMENT MECHANISMS AND THEIR SIMULATION**

V J Kremesec and J C Slattery (Northwestern Univ) Oct 1978 46 p refs

(Contract W-31-109-eng-38)

(ANL/ES-74) Avail NTIS HC A03/MF A01

Current literature is reviewed and criticized in order to explain the qualitative features of the oil displacement process and to point out those areas needing additional research. A comprehensive research program is outlined. The engineering aspects of the design and prediction of micellar/polymer floods in oil reservoirs are examined with emphasis on the physical mechanisms of oil displacement, the parameters that govern those mechanisms, and the numerical simulation of the process. It is felt that these have not been emphasized in the nationally supported research effort to make enhanced oil recovery a viable process.

DOE

**N79-32629#** Little (Arthur D.), Inc., Cambridge, Mass  
**ENERGY CONSERVATION OPPORTUNITIES IN APPLI-  
ANCES USING ENERGY STORAGE Final Report**

W Thompson Lawrence, Elia P Demetri, and David W Lee  
30 Nov 1978 203 p refs

(Contract W-7405-eng-26)

(ORNL/SUB-7303/1) Avail NTIS HC A10/MF A01

Fuel-fired appliances, electric appliances, and utility load leveling by energy storage on the customer's side of the meter were considered. For each of the appliances treated various energy storage techniques were evaluated by estimating the energy savings and the cost of the required storage system. An estimate of the commercial feasibility of each system was made based on the years necessary to pay back the cost of the storage system. In addition, when alternate approaches could be used to improve the efficiency of the appliance without energy storage, the costs of these methods were considered in the evaluation. The analyses found that the most promising applications involved the use of point-of-use thermal energy storage for electric utility load-leveling. However, although substantial utility operating cost savings can be achieved, there may be little or no actual energy saving when all losses are considered. For applications other than load-leveling, energy savings were too small to pay back the added cost of the storage system in an acceptable time.

Author

**N79-32631\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**CHARACTERIZATION OF SOLAR CELLS FOR SPACE  
APPLICATIONS. VOLUME 9: ELECTRICAL CHARACTERIS-  
TICS OF SPECTROLAB BSF, TEXTURED, 10-OHM-CM  
200-MICRON CELLS AS A FUNCTION OF INTENSITY,  
TEMPERATURE, AND IRRADIATION**

B E Anspaugh, D M Beckert, R G Downing, T F Miyahira,  
and R S Weiss 15 Sep 1979 43 p refs

(Contract NAS7-100)

(NASA-CR-162289, JPL-Pub-78-15-Vol-9) Avail NTIS  
HC A03/MF A01 CSCL 10A

Electrical characteristics of textured, back surface field, 10 ohm cm, 200 micron silicon solar cells are presented. A filtered solar simulator was used in order to approximate the spectral distribution of space sunlight. The temperature range covered was from -160 C to 140 C while the solar intensity range covered was 5 mW/sq cm to 250 mW/sq cm. The data were taken at each environment point in the matrix in the form of an I-V curve.

A W H

**N79-32632\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**A PRELIMINARY ASSESSMENT OF SMALL STEAM  
RANKINE AND BRAYTON POINT-FOCUSING SOLAR  
MODULES**

E J Roschke, L Wen, H Steele, N ElGabalawi, and J Wang  
1 Mar 1979 140 p refs Prepared for DOE

(Contract NAS7-100, JPL Proj 5104-38)

(NASA-CR-162302, JPL-Pub-79-21, DOE/JPL-1060-16) Avail  
NTIS HC A07/MF A01 CSCL 10B

A preliminary assessment of three conceptual point-focusing distributed solar modules is presented. The basic power conversion units consist of small Brayton or Rankine engines individually coupled to two-axis, tracking, point-focusing solar collectors. An array of such modules can be linked together, via electric transport,

to form a small power station. Each module also can be utilized on a stand-alone basis, as an individual power source.

Author

**N79-32633\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**LSA PROJECT TECHNOLOGY DEVELOPMENT UPDATE  
Low-Cost Solar Array Project**

John V Goldsmith and Donald B Bickler 30 Aug 1978 26 p  
Presented at 10th Project Integration Meeting, Pasadena, Calif.,  
16-17 Aug 1978. Prepared for DOE.

(Contract NAS7-100, JPL Proj 5101-104)

(NASA-CR-162301, JPL-Pub-79-26, DOE/JPL-1012-7) Avail  
NTIS HC A03/MF A01 CSCL 10A

The state of low cost solar array technology is discussed. The goal of achieving \$500/kW by 1986 is also discussed.

R E S

**N79-32635\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**RESULTS OF THE 1978 NASA/JPL BALLOON FLIGHT  
SOLAR CELL CALIBRATION PROGRAM**

C H Seaman and L B Sidwell 1 Sep 1979 13 p refs

(Contract NAS7-100)

(NASA-CR-162298, JPL-Pub-79-66) Avail NTIS  
HC A02/MF A01 CSCL 10A

The 1978 scheduled solar cell calibration balloon flight was successfully completed. Thirty six modules were carried to an altitude of above 36 kilometers. Recovery of telemetry and flight packages was without incident. These calibrated standard cells are used as reference standards in simulator testing of cells and arrays with similar spectral response characteristics. The factors affecting the spectral transmission of the atmosphere at various altitudes are summarized.

A W H

**N79-32637\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va  
**COMPARISON OF ALTERNATE FUELS FOR AIRCRAFT**

Robert D Witcofski Sep 1979 38 p refs Presented at the  
International DGLR/DFLR Symp on Hydrogen in Air Transporta-  
tion Stuttgart, Germany, 11-14 Sep 1979.  
(NASA-TM-80155) Avail NTIS HC A03/MF A01 CSCL  
21D

Liquid hydrogen, liquid methane, and synthetic aviation kerosene were assessed as alternate fuels for aircraft in terms of cost, capital requirements, and energy resource utilization. Fuel transmission and airport storage and distribution facilities are considered. Environmental emissions and safety aspects of fuel selection are discussed and detailed descriptions of various fuel production and liquefaction processes are given. Technological deficiencies are identified.

K L

**N79-32638\*#** Hughes Aircraft Co., El Segundo, Calif  
Space and Communications Group

**CONCEPTUAL DESIGN STUDY OF CONCENTRATOR  
ENHANCED SOLAR ARRAYS FOR SPACE APPLICATIONS  
VOLUME 1: STUDY OVERVIEW AND SUMMARY Interim  
Final Report**

15 May 1979 18 p ref

(Contracts NAS7-100, JPL-955194)

(NASA-CR-162328, HAC-REF-E3256-Vol-1) Avail NTIS  
HC A02/MF A01 CSCL 10A

The enhancement of arrays of thin silicon solar cells was studied, including the investigation of thin gallium arsenide cells and conventional thick silicon cells on a rigid substrate. Concentrator concepts employing thin film Kapton mirrors were evaluated for performance in space environments.

A W H

**N79-32639\*#** Hughes Aircraft Co., El Segundo, Calif  
Space and Communications Group

**CONCEPTUAL DESIGN STUDY OF CONCENTRATOR  
ENHANCED SOLAR ARRAYS FOR SPACE APPLICATIONS  
VOLUME 2: TECHNICAL Interim Final Report**

15 May 1979 115 p ref

(Contracts NAS7-100, JPL-955194)

(HAC-REF-E3256-VOL-2) Avail NTIS HC A06/MF A01 CSCL  
10A

Concentrator concepts which utilize Kapton mirror material were evaluated and selected for solar array use due to their zero mass. All concepts considered employed thin silicon solar cells. Design requirements for the concentrator were the cell temperature was not to exceed 150 C, the concentrators were to produce illumination of the array within 15% of being perfectly uniform, the concentrators were to operate while misaligned as much as 5 degrees with the solar axis. Concentrator designs along with mirror structure and configurations are discussed and comparisons are made for optimal space applications. A W H

**N79-32640\*#** National Aeronautics and Space Administration  
Lewis Research Center, Cleveland, Ohio  
**SOLAR CELL HIGH EFFICIENCY AND RADIATION DAMAGE, 1979**

Aug 1979 290 p refs Conf held at Cleveland, 13-14 Jun 1979  
(NASA-CP-2097, D-133) Avail NTIS HC A13/MF A01 CSCL 10A

Progress in the effort to increase the end-of-life efficiency of solar cells for space use is assessed. Silicon solar cell efficiency, radiation effects, and gallium arsenide cells are emphasized.

**N79-32641\*#** National Aeronautics and Space Administration  
Lewis Research Center, Cleveland, Ohio  
**THE NASA LEWIS RESEARCH CENTER PROGRAM IN SPACE SOLAR CELL RESEARCH AND TECHNOLOGY**  
Henry W Brandhorst, Jr /in its Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 1-4

Avail NTIS HC A13/MF A01 CSCL 10A

Progress in space solar cell research and technology is reported. An 18 percent-AMO-efficient silicon solar cell, reduction in the radiation damage suffered by silicon solar cells in space, and high efficiency wrap-around contact and thin (50 micrometer) coplanar back contact silicon cells are among the topics discussed. Reduction in the cost of silicon cells for space use, cost effective GaAs solar cells, the feasibility of 30 percent AMO solar energy conversion, and reliable encapsulants for space blankets are also considered. J M S

**N79-32642\*#** Air Force Aero Propulsion Lab, Wright-Patterson AFB, Ohio  
**SOLAR PHOTOVOLTAIC RESEARCH AND DEVELOPMENT PROGRAM OF THE AIR FORCE AERO PROPULSION LABORATORY**

Joseph Wise /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 5-8

Avail NTIS HC A13/MF A01 CSCL 10A

Progress is reported in the following areas: laser weapon effects, solar silicon solar cell concepts, and high voltage hardened, high power system technology. Emphasis is placed on solar cells with increased energy conversion efficiency and radiation resistance characteristics for application to satellite power systems. J M S

**N79-32643\*#** Jet Propulsion Lab, Calif Inst of Tech, Pasadena  
**THE JPL SPACE PHOTOVOLTAIC PROGRAM**

John A Scott-Monck /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 9-12  
(Contract NAS7-100)

Avail NTIS HC A13/MF A01 CSCL 10A

The development of energy efficient solar cells for space applications is discussed. The electrical performance of solar cells as a function of temperature and solar intensity and the influence of radiation and subsequent thermal annealing on the electrical behavior of cells are among the factors studied. Progress in GaAs solar cell development is reported with emphasis on improvement of output power and radiation resistance to demonstrate a solar cell array to meet the specific power and stability requirements of solar power satellites. J M S

**N79-32644\*#** National Aeronautics and Space Administration  
Langley Research Center, Hampton, Va  
**LANGLEY PROGRAM OF GaAs SOLAR CELLS**  
E J Conway /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 13-14

Avail NTIS HC A13/MF A01 CSCL 10A

A brief overview of the development of GaAs solar cell technology is provided. An 18 to 20 percent AMO efficiency, stability under radiation and elevated-temperature operation, and high power-to-weight ratio are among the factors studied. Cell cost and availability are also examined. J M S

**N79-32645\*#** Pennsylvania Univ, Philadelphia  
**UPDATING THE LIMIT EFFICIENCY OF SILICON SOLAR CELLS**

M Wolf /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 15-34 refs  
Sponsored in part by DOE

(Contract JPL-KM-68903)

Avail NTIS HC A13/MF A01 CSCL 10A

Evaluation of the limit efficiency based on the simplest, most basic mathematical method that is appropriate for the conditions imposed by the cell model is discussed. The methodology, the solar cell structure, and the selection of the material parameters used in the evaluation are described. The results are discussed including a set of design goals derived from the limit efficiency. J M S

**N79-32646\*#** Comsat Labs, Clarksburg, Md  
**LIMITING PROCESS IN SHALLOW JUNCTION SOLAR CELLS**

A Meulenber and E Rittner /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 35-36 Submitted for publication.

Avail NTIS HC A13/MF A01 CSCL 10A

In extending the violet and nonreflective cell technology to lower resistivities, several processes limiting output power were encountered. The most important was the dark diffusion current due to recombination at the front grid contacts. After removal of this problem by reduction of the silicon metal contact area (to 0.14 percent of the total area), the electric field enhanced junction recombination current  $J_{sub r}$  was the main limitation. Alteration of the diffusion profile to reduce the junction field is shown to be an effective means of influencing  $J_{sub r}$ . The remaining problems are the bulk recombination in the  $n+$  layer and the surface recombination at the oxide-silicon interface, both of these problems are aggravated by band-narrowing resulting from heavy doping in the diffused layer. Experimental evidence for the main limitations is shown, where increased diffusion temperature is seen to reduce both the influence of the front grid contacts and the junction electric field by increasing the junction depth. The potential for further significant improvement in efficiency appears to be high. J M S

**N79-32647\*#** Florida Univ, Gainesville Dept of Electrical Engineering

**DESIGN OF HIGH EFFICIENCY HLE SOLAR CELLS FOR SPACE AND TERRESTRIAL APPLICATIONS**

A Neugroschel and F A Lindholm /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 37-50 refs  
(Grant NSG-3018)

Avail NTIS HC A13/MF A01 CSCL 10A

A first-order analysis of HLE cells is presented for both beginning-of-life and end-of-life conditions. Based on this analysis and on experimentally observed values for material parameters. Design approaches for both space and terrestrial cells are presented. The approaches result in specification of doping levels, junction depths, and surface conditions. The proposed structures are projected to have both high  $V_{sub OC}$  and high  $J_{sub SC}$ . J M S

**N79-32648\*#** Spire Corp., Bedford, Mass  
**APPLICATIONS OF ION IMPLANTATION TO HIGH PERFORMANCE, RADIATION TOLERANT SILICON SOLAR CELLS**

Allen R Kirkpatrick, John A Minnucci, and Keith W Matthei  
*In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 51-59 refs

(Contracts NAS3-20823 NAS3-21276)  
 Avail NTIS HC A13/MF A01 CSCL 10A

Progress in the development of ion implanted silicon solar cells is reported Effective back surface preparation by implantation, junction processing to achieve high open circuit voltages in low-resistivity cells and radiation tolerance cells are among the topics studied J M S

**N79-32649\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**OPEN-CIRCUIT VOLTAGE IMPROVEMENTS IN LOW-RESISTIVITY SOLAR CELLS**

Michael P Godlewski, Thomas M Klucher, George A Mazaris, and Victor G Weizer *In its* Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 61-70 refs

Avail NTIS HC A13/MF A01 CSCL 10A

Mechanisms limiting the open-circuit voltage in 0.1 ohm-cm solar cells were investigated It was found that a rather complicated multistep diffusion process could produce cells with significantly improved voltages The voltage capabilities of various laboratory cells were compared independent of their absorption and collection efficiencies This was accomplished by comparing the cells on the basis of their saturation currents or, equivalently comparing their voltage outputs at a constant current-density level The results show that for both the Lewis diffused emitter cell and the Spire ion-implanted emitter cell the base component of the saturation current is voltage controlling The evidence for the University of Florida cells although not very conclusive suggests emitter control of the voltage in this device The data suggest further that the critical voltage-limiting parameter for the Lewis cell is the electron mobility in the cell base R E S

**N79-32650\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland Ohio  
**MODELING OF THIN, BACK-WALL SILICON SOLAR CELLS**

Cosmo R Baraona *In its* Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 73-78 refs

Avail NTIS HC A13/MF A01 CSCL 10A

The performance of silicon solar cells with p-n junctions on the nonilluminated surface (i.e., upside-down or back-wall cells) was calculated These structures consisted of a uniformly shaped p-type substrate layer, a p(+) type field layer on the front (illuminated) surface and a shallow n-type junction on the back (nonilluminated) surface A four-layer solar cell model was used to calculate efficiency open-circuit voltage, and short-circuit current The effect on performance of p-layer thickness and resistivity was determined The diffusion length was varied to simulate the effect of radiation damage The results show that peak initial efficiencies greater than 15 percent are possible for cell thicknesses or 100 micrometers or less After 10 years of radiation damage in geosynchronous orbit, thin (25 to 50 micrometers thick) cells made from 10 to 100 ohm cm material show the smallest decrease (approximately 10 percent) in performance Author

**N79-32651\*#** Texas Instruments Inc Dallas  
**DESIGN CONSIDERATIONS FOR THE TANDEM JUNCTION SOLAR CELL**

W T Matzen, B G Carbajal and R W Hardy *In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 79-85 refs Sponsored in cooperation with JPL and DOE

Avail NTIS HC A13/MF A01 CSCL 10A

Structure and operation of the tandem junction cell (TJC) are described The impact of using only back contacts is discussed A model is presented which explains operation of the TJC in terms of transistor action The model is applied to predict TJC performance as a function of physical parameters Author

**N79-32652\*#** Solarex Corp., Rockville, Md  
**THIN CELLS FOR SPACE**

G Storti, J Wohlgemuth, and C Wrigley *In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 87-95 refs

(Contracts NAS3-21250, JPL-954883)

Avail NTIS HC A13/MF A01 CSCL 10A

Research and pilot line production efforts directed towards the fabrication of high efficiency ultrathin silicon solar cells (50 micrometers) are reported Conventional ultrathin cells with air-mass-zero (AM0) efficiencies exceeding 14% and coplanar back contact cells with AM0 efficiencies up to 11.7% were developed The primary mechanisms limiting efficiency were determined in both types of cells and they are discussed within the context of further improving efficiency Results of pilot line production of conventional ultrathin cells are also presented Average AM0 efficiencies of 12% were readily achieved for 2000 cell production runs R E S

**N79-32653\*#** General Electric Co Schenectady N Y  
**HIGH EFFICIENCY CELL GEOMETRY**

R N Hall *In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 97-100

Avail NTIS HC A13/MF A01 CSCL 10A

A new silicon solar cell is described which has an array of small-area conduction paths to transport current directly through the wafer to metal electrodes on the back This design eliminates grid shadowing and many of the other losses inherent in conventional cells Early experimental units without texturing or antireflection coatings show 13.3% efficiency under air-mass-one illumination insolation Author

**N79-32654\*#** Optical Coating Lab., Inc City of Industry, Calif  
**SILICON SOLAR CELLS FOR SPACE USE PRESENT PERFORMANCE AND TRENDS**

P A Iles, F F Ho and S Khemthong *In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 101-104

Avail NTIS HC A13/MF A01 CSCL 10A

A technology assessment of present performance levels and current fabrication methods and designs is presented R E S

**N79-32656\*#** Naval Research Lab., Washington D C  
**AN INTERIM REPORT ON THE NTS-2 SOLAR CELL EXPERIMENT**

Richard L Statler and Delores H Walker *In* NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 117-129 refs Sponsored in part by AFAPL and SAMSO

Avail NTIS HC A13/MF A01 CSCL 10A

Data obtained from the fourteen solar cell modules on the NTS-2 satellite are presented together with a record of panel temperature and sun inclination The following flight data are discussed (1) state of the art solar cell configurations which embody improvements in solar cell efficiency through new silicon surface and bulk technology (2) improved coverslip materials and coverslip bonding techniques (3) short and long term effects of ultraviolet rejection filters vs no filters on the cells (4) degradation on a developmental type of liquid epitaxy gallium-aluminum-arsenide solar cell and (5) space radiation effects R E S

**N79-32659\*#** Boeing Aerospace Co., Seattle, Wash  
**CO2 LASER ANNEALING OF 50-MICRONS-THICK SILICON SOLAR CELLS**

Frank E Walker /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 145-160 refs

(Contract NAS9-15636)

Avail NTIS HC A13/MF A01 CSCL 10A

A test program is conducted to determine thin solar cell annealing effects using a laser energy source. A CO<sub>2</sub> continuous-wave laser was used in annealing experiments on 50 micrometers-thick silicon solar cells after proton irradiation. Test cells were irradiated to a fluence of  $1.0 \times 10^{10}$  to the 12th power protons/sq cm with 1.9 MeV protons. After irradiation those cells receiving full proton dosage were degraded by an average of 30% in output power. In annealing tests laser beam exposure times on the solar cell varied from 2 seconds to 16 seconds reaching cell temperatures of from 400 C to 500 C. Under those conditions annealing test results showed recovery in cell output power of from 33% to 90% M M M

**N79-32661\*#** Jet Propulsion Lab, Calif Inst of Tech., Pasadena  
**EFFECT OF DOPANTS ON ANNEALING PERFORMANCE OF SILICON SOLAR CELLS**

John A Scott-Monck and Bruce E Anspaugh /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 173-183 refs

(Contract NAS7-100)

Avail NTIS HC A13/MF A01 CSCL 10A

The optimum annealing parameters of time and temperature for producing cell output recovery were established. Devices made from gallium doped and boron doped silicon were investigated. The cells ranged in resistivity from 0.1 to 20 ohm-cm and in thickness from 50 to 250 micrometers. The observations can be explained in a qualitative manner by postulating a pair of competing mechanisms to account for the low temperature reverse annealing seen in most boron and gallium doped silicon solar cells. Still another mechanism dominates at higher temperatures (350 C and greater) to complete this model. One of the mechanisms, defined as B, allows migrators to couple with radiation induced recombination sites thus increasing or enhancing their capture cross sections. This would tend to reduce minority carrier diffusion length. The new recombination complex is postulated to be thermally stable up to temperatures of approximately 350 C. M M M

**N79-32663\*#** National Aeronautics and Space Administration  
 Langley Research Center Hampton Va  
**RADIATION DAMAGE IN GaAs SOLAR CELLS**

E J Conway and G H Walker /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 201-207 refs

Avail NTIS HC A13/MF A01 CSCL 10A

Recent results of electron and proton irradiation and annealing of GaAs solar cells are presented along with some implications of these results. A comparison between the energy-levels produced by protons and by electrons which are not stopped in the material indicate that the damage produced by protons and electrons may be qualitatively different. Thus, annealing of proton damage may be very different from the annealing of electron damage. M M M

**N79-32664\*#** Jet Propulsion Lab., Calif Inst of Tech., Pasadena  
**FABRICATION OF HIGH EFFICIENCY AND RADIATION RESISTANT GaAs SOLAR CELLS**

S Kamath, R C Knechtli, R Loo and Bruce E Anspaugh /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 209-216 Prepared in cooperation with Hughes Res Labs, Malibu, Calif

(Contracts NAS1-14727 F33615-77-C-3150)

Avail NTIS HC A13/MF A01 CSCL 10A

Systematic improvements in fabrication yield were obtained by appropriate control of the liquid phase epitaxial growth process. contact fabrication and surface preparation. To improve radiation hardness the junction depth was decreased while overcoming the penalty in decreased solar cell efficiency which tends to go hand-in-hand with the reduction of junction depth in (AlGa) As-GaAs solar cells. Cells were made with an AMO efficiency of 18% and a junction depth of 0.5 micrometers as compared to junction depths on the order of 1.0 micrometers. With respect to the damage caused by proton irradiation, the nature of the observed damage was correlated to the energy and penetration depth of the damaging protons. M M M

**N79-32666\*#** Lincoln Lab., Mass Inst of Tech., Lexington  
**SHALLOW-HOMOJUNCTION GaAs SOLAR CELLS**

John C C Fan /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 227-233 refs Sponsored in part by AF

Avail NTIS HC A13/MF A01 CSCL 10A

Single-crystal GaAs shallow-homojunction solar cells on GaAs or Ge substrates without Ga sub 1-x Al sub x As window layers that have conversion efficiencies exceeding 20% at AM1 (17% at AMO). Using a simple theoretical model, good fits were obtained between computer calculations and experimental data for external quantum efficiency and conversion efficiency of cells with different values of n+ layer thickness. The calculations not only yield values for material properties of the GaAs layers composing the cells but will also permit the optimization of cell designs for space and terrestrial applications. Preliminary measurements indicate that the shallow-homojunction cells are resistant to electron irradiation. In the best test so far, bombardment with  $1 \times 10^{10}$  to the 16th power/sq cm fluence of 1 MeV electrons reduced the short-circuit current by only about 6%. G Y

**N79-32671\*#** Bureau of Mines Washington D C  
**EFFICIENCY OF TANDEM SOLAR CELL SYSTEMS AS FUNCTION OF TEMPERATURE AND SOLAR ENERGY CONCENTRATION RATIO**

N A Gokcen and J J Loferski (Brown Univ) /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage 1979 Aug 1979 p 263-265

Avail NTIS HC A13/MF A01 CSCL 10A

The results of a comprehensive theoretical analysis of tandem photovoltaic solar cells as a function of temperature and solar concentration ratio are presented. The overall efficiencies of tandem cell stacks consisting of as many as 24 cells having gaps in the 0.7 to 3.6 eV range were calculated for temperatures of 200, 300, 400, and 500 K and for illumination by an AMO solar spectrum having concentration ratios of 1, 100, 500, and 1000 suns. For ideal diodes ( $A = B = 1$ ), the calculations show that the optimized overall efficiency has a limiting value eta sub opt of approximately 70 percent for  $T = 200$  K and  $C = 1000$ , for  $T = 300$  K and  $C = 1000$  this limiting efficiency approaches 60 percent. G Y

**N79-32672\*#** Research Triangle Inst., Research Triangle Park, N C

**COMPUTER MODELING OF A TWO-JUNCTION, MONOLITHIC CASCADE SOLAR CELL**

M F Lamorte and D Abbott /in NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 267-281 refs Sponsored in cooperation with AFAL, DOE and Sandia Labs, Albuquerque N Mex

Avail NTIS HC A13/MF A01 CSCL 10A

The theory and design criteria for monolithic, two-junction cascade solar cells are described. The departure from the conventional solar cell analytical method and the reasons for using the integral form of the continuity equations are briefly discussed. The results of design optimization are presented. The energy conversion efficiency that is predicted for the optimized



structure is greater than 30% at 300 K, AMO and one sun. The analytical method predicts device performance characteristics as a function of temperature. The range is restricted to 300 to 600 K. While the analysis is capable of determining most of the physical processes occurring in each of the individual layers, only the more significant device performance characteristics are presented. Author

**N79-32673\*** Rockwell International Corp., Thousand Oaks, Calif. Electronics Research Center  
**INTERCELL OHMIC CONTACTS FOR HIGH EFFICIENCY MULTIJUNCTION SOLAR CONVERTERS**  
 Stanley W Zehr, D L Miller, and J S Harris, Jr. /n NASA Lewis Res Center Solar Cell High Efficiency and Radiation Damage, 1979 Aug 1979 p 283-291 refs

(Contract F33615-78-C-2036)

Avail NTIS HC A13/MF A01 CSCL 10A

The monolithic multijunction converter is an attractive approach to achieving solar/electric conversion with greater than 30% efficiency. A major technical challenge in the development of such devices is the requirement for low resistance optically transparent intercell contacts between adjacent junctions. These contacts should transmit, without significant loss, the spectral fraction of the incident sunlight which is not absorbed and converted in the overlying junction materials. Their contact resistances must be low enough to prevent significant I to the 2d power R loss at the designed current density levels. They should also exhibit adequate thermal conductivity to prevent device overheating when subjected to the designed illumination level. Recent encouraging results for the development of such contacts are presented. G Y.

**N79-32677** Oak Ridge National Lab., Tenn.  
**DECENTRALIZED SOLAR ENERGY TECHNOLOGY ASSESSMENT PROGRAM: RESEARCH PLAN**

B H Bronfman, M Schwitzer, S A Carnes, E Peele, G Samuels, Jr., and T J Wilbanks May 1979 53 p refs

(Contract W-7405-eng-26)

(ORNL/TM-6913) Avail NTIS HC A04/MF A01

The social, political, institutional and life-style impacts of the widespread adoption of decentralized solar technology are assessed. The major components are described and the research plan for the Technology Assessment Program is presented. Responsibilities, milestones and deliverables for all components are identified where applicable. DOE

**N79-32678** Los Alamos Scientific Lab., N Mex.  
**ENERGY EXTRACTION OPERATIONS: SOME PRELIMINARY RESULTS**

R H Hendron 1979 10 p refs Presented at 3d US Natl Congr on Pressure Vessels and Piping, San Francisco, 25 Jun 1979

(Contract W-7405-eng-36)

(LA-UR-79-679, Conf-790615-10)

Avail NTIS

HC A02/MF A01

Thermal energy was extracted from Precambrian granitic rock by injection and circulating water through fractured zones or reservoirs. Two boreholes were drilled to depths of about 3 km (10,000 ft) in a location selected for high heat flow and an apparent lack of faulting. Bottom-hole temperature was 205 C (400 F). The holes were connected at depth by hydraulic fracturing to form a flow path and heat extraction surface. Energy has been extracted at rates exceeding 5 MW(t) in three operations totaling 2847 h. These operations are summarized. DOE

**N79-32679** Los Alamos Scientific Lab., N Mex.  
**THE FUTURE OF HOT DRY ROCK GEOTHERMAL ENERGY SYSTEMS**

Morton C Smith 1979 13 p refs Presented at 3d US Natl Congr on Pressure Vessels and Piping, San Francisco, 25 Jun 1979

(Contract W-7405-eng-36)

(LA-UR-79-683, Conf-790615-12)

Avail NTIS

HC A02/MF A01

The magnitude and distribution of hot dry rock and the variety of possible heat extraction techniques were studied. It is concluded that this energy supply can eventually be used on a large scale. DOE

**N79-32680** Mound Lab., Miamisburg, Ohio  
**EVALUATION OF A LARGE NONCONVECTIVE SOLAR POND**

Layton J Wittenberg and Marc J Harris 1979 12 p refs Presented at the Solar Energy Storage Options Workshop, San Antonio, 18 Mar 1979

(Contract EY-76-C-04-0053)

(MLM-2608(OP), Conf-790328-2) Avail NTIS HC A02/MF A01

The operational performance of one of the largest functional, salt-gradient solar ponds in the world is evaluated. This solar pond was constructed by the City of Miamisburg on property adjacent to the Mound Facility. Data are collected on the annual thermal cycle characteristics of this combined solar energy collector and thermal storage system, and system performance is evaluated based upon models developed at several university research ponds. DOE

**N79-32681** Sandia Labs., Albuquerque, N Mex. Experimental Systems Operations Div  
**PERFORMANCE TESTING OF THE DEL CONCENTRATING SOLAR COLLECTOR**

Vernon E Dudley (Edgerton, Germeshausen and Grier, Inc., Albuquerque, N Mex) and Robert M Workhoven Apr 1979 28 p refs

(Contract EY-76-C-04-0789)

(SAND-79-0516) Avail NTIS HC A03/MF A01

The results of tests performed on the Del Solar Collector at the Midtemperature Solar Systems Test Facility are summarized. Test objectives are defined, test procedures are described, and test results and conclusions are given. DOE

**N79-32682** Colorado State Univ., Fort Collins. Solar Energy Applications Lab

**STRATIFIED THERMAL STORAGE IN RESIDENTIAL SOLAR ENERGY APPLICATIONS**

M K Sharp and R I Lohrke Washington DOE Jun 1978 64 p refs

(Contract EG-77-S-02-4523, N68305-76-0036)

(COO-4523-1) Avail NTIS HC A04/MF A01

The benefits of thermal stratification in sensible heat storage were investigated for several residential solar applications. The operation of space heating, air conditioning and water heating systems with water storage was simulated on a computer. The performance of comparable systems with mixed and stratified storage was determined in terms of the fraction of the total load supplied by solar energy. The effects of design parameters such as collector efficiency, storage volume, tank geometry, etc., on the relative advantage of stratified over well-mixed storage were assessed. DOE

**N79-32683** Sandia Labs., Albuquerque, N Mex.  
**CORROSION IN MOLTEN SALTS USED FOR SOLAR THERMAL STORAGE APPLICATIONS**

William H Smyrl 1978 12 p refs Presented at the Reliability of Mater Workshop, Denver, 18 Dec 1978

(Contract EY-76-C-04-0789)

(SAND-79-0246C, Conf-781228-1)

Avail NTIS

HC A02/MF A01

Some of the broad outlines of corrosion behavior are discussed. The compatibility of materials with the molten nitrate-nitrite class of salts selected for solar thermal storage applications is discussed at some length. A brief summary is given of recommendations for areas of future work on these salts to increase the reliability of materials behaviors in solar systems. Author (DOE)

**N79-32684** California Univ., Berkeley. Lawrence Berkeley Lab

**DESCRIPTION OF THE 3-DIMENSIONAL 2-PHASE SIMULATOR SHAFT78 FOR USE IN GEOTHERMAL RESERVOIR STUDIES**

Karsten Pruess, J Mike Zerzan Ron C Schroeder and Paul A Witherspoon Jan 1979 17 p refs Presented at the 5th Symp on Reservoir Simulation, Denver, 31 Jan 1979 (Contract W-7405-eng-48)

(LBL-8802 Conf-790119-2) Avail NTIS HC A02/MF A01

The algorithm of SHAFT78, based on mass and energy balance equations for two phase flow in a porous medium is described with emphasis on its application to geothermal reservoir studies. Finite difference equations are obtained by integrating the basic partial differential equations for mass and energy flow over arbitrary polyhedral volume elements regular and irregular reservoir shapes are handled with the same ease. The equations are solved semi-implicitly for discrete time steps and the coupling between mass and energy flow is treated in a noniterative way. Results of calculations for idealized systems which verify the program and give insight into the pressure response of two phase reservoirs during production are discussed. DOE

**N79-32686#** Brown Univ, Providence, R I Engineering Div  
**AVAILABLE WORK IN GEOTHERMAL ENERGY**

Joseph Kestin Jul 1978 95 p refs

(Contract EY-76-S-02-4051)

(COO-4051-25) Avail NTIS HC A05/MF A01

The most important thermodynamic considerations needed for a clear understanding of the operation of geothermal installations used for the production of electricity are presented. A brief description is given of the nature of a geothermal reservoir and the characteristics of the most practical systems for the conversion of geothermal energy into work are described. The shortcomings of the method of cycle analysis are discussed when applied to geothermal plants. Special attention is devoted to a detailed discussion of the most important general indicators that follow for the designer from a thermodynamic analysis. Various methods of graphically interpreting the concept of available work are described in detail and the importance of easily accessible, reliable formulations of the thermophysical properties of the pure substances, solutions, and mixtures that the designer needs for success are discussed. DOE

**N79-32686#** University of Southeastern Massachusetts, North Dartmouth

**GEOTHERMAL POWER PLANTS OF THE SOVIET UNION  
A TECHNICAL SURVEY OF EXISTING AND PLANNED  
INSTALLATIONS**

R DiPippo Jan 1979 25 p refs Prepared in cooperation with Brown Univ

(Contract EY-76-S-02-4051)

(COO-4051-41) Avail NTIS HC A02/MF A01

Some of the geothermal areas in the Soviet Union which may support electric generating stations are described. The plants at Pauzhetka (single-flash steam) at Paratunka (Freon binary), and at Bolshoye-Bannoye (multi-flash steam) are described in technical detail. The reference list contains some of the most recent sources of information on geothermal power plant developments in the Soviet Union. DOE

**N79-32687#** Aerospace Corp, El Segundo, Calif  
**SOLAR HEATING AND COOLING OF BUILDINGS  
(SHACOB) REQUIREMENTS DEFINITION AND IMPACT  
ANALYSIS**

C K Cretcher and W C Melton Jun 1978 82 p refs Sponsored by Elec Power Res Inst

(EPRI Proj 553)

(EPRI-ER-808-SY) Avail NTIS HC A05/MF A01

The economic impact of various (SHACOB) design concepts on the electric utilities and their customers was assessed along with system requirements for optimizing this impact. Weather and insolation inputs for simulations were established for locations across the United States. Reference buildings and their thermal properties were defined, and detailed internal and external load models generated to characterize building thermal performance. Both solar and conventional systems, including load management systems featuring nighttime thermal storage were simulated. The systems analyzed in detail were direct solar systems with and

without a load management capability solar assisted heat pumps and customer load management systems. These systems were evaluated with respect to conventional resistive and heat pump systems. Projections for buildings and types of heating system installations in those buildings were developed by eight participating utilities for their own service areas. DOE

**N79-32688#** Midwest Research Inst, Golden, Colo  
**SOLAR THERMAL TEST FACILITIES USERS ASSOCIATION**

C J Bishop Jan 1979 54 p refs

(Contract EG-77-C-01-4042)

(SERI/PR-13-154) Avail NTIS HC A04/MF A01

The current status and needs of high temperature research is summarized along with some of the experiments which might be undertaken in the solar thermal test facilities (STTF). The use of high temperatures for industrial processes is also reviewed. Proposals received and reviewed by the STTF Users Association are included. Operation of the STTFUA is described with emphasis on dissemination of information on the STTF through conferences, workshops, and newsletters. J M S

**N79-32689#** Midwest Research Inst, Golden, Colo Solar Energy Research Inst

**SOLAR REPOWERING WORKSHOP Summary Report**

D Nordman 2 Aug 1978 31 p Presented at Workshop on Solar Repowering Denver, 2 Aug 1978

(Contract EG-77-C-01-4042)

(SERI/TP-35-57 Conf-780894-Summ)

Avail NTIS

HC A03/MF A01

The demand for solar thermal technologies is discussed along with the key issues in the supply of solar thermal technologies. Discussion questions are listed and the responses are summarized. DOE

**N79-32690#** Los Alamos Scientific Lab, N Mex  
**FEDERAL HOT DRY ROCK GEOTHERMAL ENERGY  
DEVELOPMENT PROGRAM AN OVERVIEW**

Gregory J Nunz 1979 8 p refs Presented at 3d US Natl Congr on Pressure Vessels and Piping San Francisco, 25 Jun 1979

(Contract W-7405-eng-36)

(LA-UR-79-670, Conf-790615-9)

Avail NTIS

HC A02/MF A01

The formulation and evolution of the Federal hot dry rock geothermal energy development program were traced. Accomplishments to date, including the establishment and evaluation of the 5 MW sub t phase one reservoir at Fenton Hill, NM, and various instrument and equipment developments, are discussed. Future plans presented include (1) establishment of a 20 to 50 MW sub t phase 2 reservoir at Fenton Hill that will be used to demonstrate longevity and, eventually, electric power production and (2) the selection of a second site at which a direct thermal application will be demonstrated. DOE

**N79-32691#** Arizona State Univ, Tempe  
**COMBINED PHOTOVOLTAIC/THERMAL SYSTEM STUDIES**

D L Evans, W A Facinelli, and R T Otterbein Aug 1978 183 p refs

(Contract EY-76-C-04-0789)

(SAND-78-7031) Avail NTIS HC A09/MF A01

Modelling of concentrating combined collectors (those that produce both electricity from solar cells as well as thermal energy from the sun's rays) is discussed. Particular attention is devoted to accurately modelling the IV curves of present day 2 x 2 cm silicon cells designed for concentration. Also discussed is modelling of storage batteries, regulators and inverters all of which are usually found in photovoltaic systems. The models devised were formalized in subroutines that are compatible with TRNSYS. Some preliminary systems studies for both constant collector inlet fluid temperature and floating temperature systems are reported. DOE

**N79-32692#** Battelle Pacific Northwest Labs., Richland, Wash  
**SYSTEMS ANALYSIS OF SOLAR THERMAL POWER SYSTEMS. REPORT ON TASK 1 DETERMINATION AND CHARACTERIZATION OF SOLAR THERMAL CONVERSION OPTIONS**

W J Apley Jul 1978 65 p  
 (Contract EY-76-C-06-1830)  
 (PNL-2693) Avail NTIS HC A04/MF A01

Seven general solar thermal conversion concepts were selected initially. The literature review confirmed that these are the only concepts that are developed to a level suitable for inclusion in the comparative analysis to be performed. A summary of information pertaining to these concepts is given and the concepts are briefly described. The seven concepts are point-focusing distributed receiver system, point focusing central receiver systems, fixed mirror/distributed focus system, line-focus central receiver system, line-focus distributed receiver system, fixed mirror line-focus distributed receiver system, and low concentrator non-tracking systems. Author (DOE)

**N79-32693#** California Univ Livermore Lawrence Livermore Lab

**PERFORMANCE TESTS OF THE RADIAL OUTFLOW REACTION TURBINE FOR GEOTHERMAL APPLICATIONS**

P A House 21 Aug 1978 11 p refs  
 (Contract W-7405-eng-48)  
 (UCID-17902) Avail NTIS HC A02/MF A01

A pure reaction turbine for geothermal applications, was developed. This radial outflow reaction turbine is designed specifically to produce power from the expansion of saturated or compressed liquid at temperatures of less than 180 C. In the tests reported here the highest efficiency measured was 32.7%, clearly below the peak efficiency for this small machine. Extrapolations to larger machines indicate that an efficiency near 50% is a credible goal, an attractive performance as either a total flow expander for liquid or in conjunction with conventional flashed steam systems. The development and proof of feasibility of efficient liquid expanders broadens the opportunities for economic power production from lower temperature geothermal resources and possibly utilization of waste heat in industrial processes. DOE

**N79-32694#** Sandia Labs Albuquerque, N Mex Solar Project Div

**THERMAL ENERGY STORAGE FOR ADVANCED SOLAR CENTRAL RECEIVER POWER SYSTEMS**

L G Radosevich Aug 1978 35 p refs  
 (Contract EY-76-C-04-0789)  
 (SAND-78-8221) Avail NTIS HC A03/MF A01

Thermal energy storage is used in the advanced solar central receiver power systems currently being studied under Department of Energy sponsorship. The following are described: (1) the storage operating requirements imposed by interface constraints between energy storage and the receiver and electrical power generation systems, (2) several storage concept candidates which may meet these requirements, (3) potential cost differences between each of the storage concepts and (4) the technical uncertainties associated with each storage concept. DOE

**N79-32695#** California Univ Livermore Lawrence Livermore Lab

**DEMONSTRATION OF THE CAPABILITIES OF THE LIVERMORE ENERGY POLICY MODEL**

S S Sussman and W F Rousseau Jul 1978 34 p refs  
 (Contract W-7405-eng-48)  
 (UCRL-52508) Avail NTIS HC A03/MF A01

A computer tool is described which can analyze, within the framework of a general equilibrium model, the potential economic effects of government policies that alter free-market equilibrium in the energy sector. Aspects of the model discussed are the specification of input data and output formats, and the use of a new language for defining the energy network and data. DOE

**N79-32696#** Department of Energy Washington D C  
**FOSSIL ENERGY PROGRAM SUMMARY DOCUMENT**

Mar 1979 484 p refs  
 (DOE/ET-0087) Avail NTIS HC A21/MF A01

The programs and projects involving the fossil energy resources of the United States (coal, petroleum, natural gas, and oil shales) are described in detail. Commercialization, environmental, and socio-economic issues involved in these activities are of prime consideration. The contributions of the energy technology centers and national laboratories to the overall goals of the Fossil Energy Program are summarized. International programs on the production and utilization of fossil fuels are described. The requested funding for FY 1980 is \$747.6 million, of which \$662.7 million is planned for coal, \$57.4 million for petroleum, and \$27.6 million for gas. DOE

**N79-32697#** Argonne National Lab Ill  
**ENERGY AND COST CALCULATIONS 1 OPTIMIZATION OF ELECTROCHEMICAL PROCESSES TO ACHIEVE MINIMUM PRODUCT COST AND THE IMPACT ON ENERGY CONSUMPTION**

R Keller Apr 1979 49 p refs  
 (Contract W-31-109-eng-38)  
 (ANL/OEPM-78-2) Avail NTIS HC A03/MF A01

In industrial electrochemical processes, the cost resulting from energy consumption and other costs are optimized by operating at an optimum current density. The interrelationships between process operating conditions, product cost, and energy consumption were studied by means of model calculations. The effect of changes in energy price and of process improvements was estimated; the energy consumption of new undeveloped processes was predicted, and electrolytic processes to produce aluminum, chlor-alkali electrolysis, and copper refining were examined. DOE

**N79-32698#** Los Alamos Scientific Lab N Mex  
**POTENTIAL PREDICTION NEEDS IN SUPPORT OF ENERGY SYSTEMS**

R L Blake 1979 7 p refs. Presented at Intern Solar-Terrestrial Predictions Workshop, Boulder, Colo, 23 Apr 1979.  
 (Contract W-7405-eng-36)  
 (LA-UR-79-673 Conf-790413-3) Avail NTIS HC A02/MF A01

Examples are given to show that energy systems are tied to global solar-terrestrial processes. The need for long term basic research on the solar-terrestrial system is emphasized. DOE

**N79-32699\*#** PRC Energy Analysis Co, McLean Va  
**ECONOMIC AND DEMOGRAPHIC ISSUES RELATED TO DEPLOYMENT OF THE SATELLITE POWER SYSTEM (SPS)**

Thomas E Baldwin, Lawrence G Hill, Danilo J Santini, and Erik J Stenehjem Oct 1978 71 p refs. Sponsored in part by NASA.  
 (Contract W-31-109-eng-38)  
 (NASA-CR-158886, ANL/EES/TM-23) Avail NTIS HC A04/MF A01 CSDL 10B

Growth in energy consumption stimulated interest in exploitation of renewable sources of electric energy. One technology that was proposed is the Satellite Power System (SPS). Before committing the U.S. to such a large program, the Department of Energy and the National Aeronautics and Space Administration are jointly participating in an SPS Concept Development and Evaluation Program. This white paper on industrial and population relocation is part of the FY 78 preliminary evaluation of related socio-economic issues. Results of four preliminary assessment activities are documented. DOE

**N79-32700#** Lincoln Lab Mass Inst of Tech Lexington

**FIELD TESTS OF PHOTOVOLTAIC POWER SYSTEMS**

M D Pope and R W Matlin 1979 10 p refs. Presented at the ASME Gas Turbine Closed-Cycle Session, San Diego, 11 Mar 1979.  
 (Contract EY-76-C-02-4094)  
 (COO-4094-32, Conf-790305-5) Avail NTIS HC A02/MF A01

Field test experience gained at existing photovoltaic test sites is discussed. These sites include a 25 kW peak power system.

at Mead, Nebraska, a 12 kW peak array at MIT/Lincoln Laboratory, a 16 kW peak PV power system at the Chicago Museum of Science and Industry, and several small (approximately 100 watts peak) arrays located in various urban and rural sites. Data are given on failures which have occurred in the field and on the frequency of unscheduled outages. Also, information is presented concerning the environmental extremes to which the systems have been exposed. Operating experience gained from these projects is discussed in the contexts of storage, reliability, safety and cost. Finally, some projects which are currently in the design are discussed. DOE

**N79-32701#** Lockheed Missiles and Space Co., Palo Alto, Calif  
Electro-Optics Lab  
**CADMIUM SULFIDE-COPPER SULFIDE HETEROJUNCTION CELL RESEARCH** Technical Progress Report, 1 Mar 1978 - 31 May 1978

30 Jun 1978 37 p  
(Contract EG-77-C-03-1459)  
(SAN-1459-3, LMSC-D626523 TPR-3) Avail NTIS  
HC A03/MF A01

The program objective is to investigate and evaluate the application of cylindrical-post magnetron reactive sputtering to the production of solar cell quality thin films of CdS/Cu<sub>2</sub>S for large scale terrestrial photovoltaic energy conversion. Cominco American has encountered difficulties in maintaining the desired 6-9 s purity while casting Cd, Cd-Zn, and Zn sputtering targets over the nickelplated copper mandrels which are used to provide strength to the overall assembly. A major activity has been a systematic study of Cu/sub x/S coatings deposited by reactive sputtering Cu in Ar-H<sub>2</sub>S gas mixtures at various injection rates (partial pressures) of H<sub>2</sub>S. The coatings were deposited on borosilicate glass substrates at substrate temperatures of about 35 C and 130 C. The coatings were analyzed with respect to electrical, optical, and structural characteristics. Van der Pauw and temperature dependence of resistivity measurements were made on selected films. Optical constants were obtained from transmission and reflection measurements. Structural and compositional measurements were made using X-ray diffraction, scanning electron microscopy microprobe, and X-ray energy spectroscopy. DOE

**N79-32702#** Lincoln Lab, Mass Inst of Tech., Lexington  
**MICROPROCESSOR-CONTROLLED AUTONOMOUS SUN-FOLLOWING MOUNT FOR SOLAR PHOTOVOLTAIC ENERGY PLANNING**

Carl H. Much, Peter L. Rossini, and David G. Stuart 1979 6 p refs. Presented at the IECI 1979 Conf on Ind Appl of Microprocessors, Philadelphia, 19-21 Mar 1979  
(Contract EY-76-C-02-4094)  
(COO-4094-34, Conf-790353-2) Avail NTIS  
HC A02/MF A01

A sun-following pyroheliometer mount and control system for support of a solar photovoltaic energy program was designed. The system features the use of a microprocessor for controlling the mount and handling complex control functions required by variations in the motion of the sun. The system is a stand-alone, unattended system with capabilities for remote diagnosis by telephone. DOE

**N79-32704#** Brookhaven National Lab., Upton, N Y  
**EXPERIMENTAL PERFORMANCE STUDY OF A SERIES SOLAR HEAT PUMP**

Edward A. Kush 1979 6 p refs. Presented at the 4th Ann Heat Pump Technol Conf., Stillwater, Okla., 9-10 Apr 1979  
(Contract EY-76-C-02-0016)  
(BNL-25928, Conf-790448-2) Avail NTIS HC A02/MF A01

A systematic experimental study of heat pump performance at evaporator temperatures typical of series solar input, 50 to 100 F, was conducted using a laboratory assembled heat pump and specially constructed testing simulator. Results which show that coefficients of performance which follow the thermodynamic potential can be achieved are presented and discussed. DOE

**N79-32705#** Zia Associates Inc., Boulder, Colo  
**HEAT PUMP/ROCK BED STORAGE SYSTEMS**

G. L. Mills and H. E. Remmers 1979 9 p refs. Presented at the Solar Energy Storage Options Workshop, San Antonio, 18 Mar 1979

(Contract EM-78-C-02-4704)  
(COO-4704-2 Conf-790328-3) Avail NTIS  
HC A02/MF A01

The characteristics of heat pump/rock bed storage components were analyzed and used to formulate TRNSYS models of potentially cost effective systems. The systems were then analyzed for performance on a typical house in Albuquerque, New Mexico and Madison, Wisconsin. Considerable emphasis was placed on system economics, since the principal goal of the project is to determine the most cost effective system. A new TRNSYS subroutine was developed to account properly for utility energy costs. DOE

**N79-32707#** Institute of Gas Technology, Chicago, Ill  
**PRODUCTION OF HIGH-ENERGY CHEMICALS USING SOLAR ENERGY HEAT** Final Report, 1 Sep 1977 - 31 May 1978

J. R. Dafler, J. Sinnott, M. Novil, B. D. Yudow and M. G. Rackoff Dec 1978 61 p refs  
(Contract W-7405-eng-26, Proj 8999)  
(ORNL/SUB-7390/1) Avail NTIS HC A04/MF A01

Techno-economic studies and thermodynamic assessments of chemical reactions and processes were made and the market potentials for major chemical commodities that use significant amounts of fossil resources were determined in order to identify energy-intensive processes that would be suitable for the production of chemicals and fuels using solar energy process heat. Of particular importance was the comparison of relative costs and energy requirements for the selected solar product versus costs for the product derived from conventional processing. The assessment methodology used a systems analytical approach to identify processes and products having the greatest potential for solar energy-thermal processing. Four conventional processes were selected for assessment: namely, methanol synthesis, styrene monomer production, vinyl chloride monomer production, and terephthalic acid production. DOE

**N79-32708#** Pennsylvania Univ., Philadelphia Dept of Mechanical Engineering and Applied Mechanics  
**ISOTHERMAL FLOW DISTRIBUTION IN SOLAR COLLECTORS AND COLLECTOR MANIFOLDS**

Gerald F. Jones and Noam Lior 1978 5 p refs. Presented at Meeting of the Am Sect of the Intern Solar Energy Soc., Denver, 28-31 Aug 1978  
(Contract EM-78-C-04-5319)  
(ALO-5319-1, Conf-780808-27) Avail NTIS  
HC A02/MF A01

As a first step to a detailed analysis of the influence of flow in solar collector absorber tubes on the collector's heat transfer and thermal performance, the distribution of isothermal flow through a typical system consisting of two manifolds connected by a number of parallel riser-tubes was investigated. No thermal effects were taken into account. A discrete hydrodynamic model was developed for this system and the resulting set of simultaneous nonlinear algebraic equations was solved numerically by the successive substitution method, for 23 different combinations of the major independent variables. Quantitative flow distribution results are presented in the investigated range; it was determined that the two parameters which have the major influence on flow distribution are the ratio of riser diameter to manifold diameter, and the number of risers, with maldistribution increasing with both of them. DOE

**N79-32709#** Battelle Pacific Northwest Labs, Richland, Wash  
**EFFECTS OF NONCONTACT CLEANERS ON TRANSPARENT SOLAR MATERIALS**

H. L. Hampton and M. A. Lind Apr 1979 72 p  
(Contract EY-76-C-06-1830)  
(PNL-2969) Avail NTIS HC A04/MF A01

A brief study was undertaken to evaluate the performance of noncontact cleaning agents for use on solar collectors. Several techniques are used to compare cleansing agents which were

recommended by their respective manufacturers for cleaning solar mirrors Wetting and residue buildup properties were evaluated for over 50 of these commercially available cleaners The wetting properties of each cleaner were evaluated by measuring the growth of the contact area of a constant volume drop as a function of time Losses due to residue buildup were solar weighted and considered equally with the wetting parameters and cost figures to construct a figure of merit for cleaner comparison  
DOE

**N79-32710#** Sandia Labs, Albuquerque, N Mex  
**STRUCTURAL OPTIMIZATION OF SHEET MOLDING COMPOUND LINE FOCUSING COLLECTORS**  
R C Reuter, Jr and R E Allred 1979 6 p refs Presented at the 24th Ann SAMPE Symp, San Francisco, 8 May 1979 (Contract EY-76-C-04-0789)  
(SAND-79-0215C Conf-790517-1) Avail NTIS HC A02/MF A01

One of the primary structural components of a line focusing solar collector is the reflector support In this design it must be a stiff, light weight, parabolic trough which provides and maintains the correct optical shape for the reflective surface and protects it from detrimental environmental effects A viable candidate for the reflector support is a moldable, fiber reinforced, rib stiffened structure which has a low cost, high production rate potential Material and analytical considerations made to insure that the sheet molding compound panel design meets specified structural requirements are described A detailed analysis is provided and optimization is achieved through steps taken to minimize panel weight  
DOE

**N79-32711#** Oak Ridge National Lab Tenn  
**WIND TURBINES**  
John C Yeoman, Jr Dec 1978 61 p refs  
(Contract W-31-109-eng-38)  
(ANL/CES/TE-78-9) Avail NTIS HC A04/MF A01

Wind turbines, ranging in size from 200 W to 10 MW, are discussed as candidates for prime movers in community energy systems Estimates of performance characteristics and cost as a function of rated capacity and rated wind speed are presented Data concerning material requirements, environmental effects, and operating procedures also are given and are represented empirically to aid computer simulation  
DOE

**N79-32713#** Mechanical Technology Inc, Latham N Y  
**DEMONSTRATION OF A FREE PISTON STIRLING ENGINE DRIVEN LINEAR ALTERNATOR SYSTEM** Annual Report 1 Sep 1978 126 p  
(Contract EY-76-C-02-2764)  
(COO-2764-002) Avail NTIS HC A07/MF A01

A linear alternator concept was demonstrated which meets design power requirements and will operate at 88 percent efficiency A free piston Stirling engine/linear alternator energy conversion system was successfully tested, demonstrating concept feasibility In particular, stable and controllable operation gas bearing operation, and engine start-up using the alternator as a driver were demonstrated A demonstrator preliminary design in which the system operating conditions and the system concept were defined was completed In addition, the detailed demonstrator design layout was completed One approach for analytically modeling free piston Stirling engines was evaluated Based on this analysis the decision was made to design the demonstrator with an existing free piston Stirling engine computer program In addition the development of a new computer program was initiated  
DOE

**N79-32714#** Los Alamos Scientific Lab, N Mex  
**STATUS REVIEW OF THE TECHNOLOGY ASSESSMENT OF SOLAR ENERGY PROGRAM** Interim Status Report  
John H Altseimer and Robert P Blaunstein (DOE Washington, D C) 1979 6 p refs Presented at the Intern Solar Energy Soc Meeting, Atlanta 28 May 1979  
(Contract W-7405-eng-36)  
(LA-UR-79-1369, Conf-790541-4) Avail NTIS HC A02/MF A01

A number of emerging solar technologies and selected applications were assessed for the environmental, institutional, and social impacts resulting from the large scale deployment of decentralized solar technologies Two national energy scenarios for the year 2000 were used, one predicting 6 quads of solar and the other 14.2 quads A few results of a preliminary study of the system characterization data are given  
DOE

**N79-32715#** Planning Research Corp, McLean, Va  
**APPLICATION AND SYSTEM DESIGN STUDY FOR COST-EFFECTIVE SOLAR PHOTOVOLTAIC SYSTEMS AT FEDERAL INSTALLATIONS**  
Mar 1979 133 p refs  
(Contract EG-77-C-01-2522)  
(HCP/M2522-01) Avail NTIS HC A07/MF A01

The results are given of an effort to identify the potential for cost effective solar photovoltaic power systems applications within the U S Federal Government An implementation plan is provided for the installation of the first phase of cost effective applications  
DOE

**N79-32716#** Los Alamos Scientific Lab, N Mex  
**SMALL-SCALE SOLAR SIMULATOR FOR INDOOR TESTING OF COLLECTOR MODULES AND MATERIALS**  
D P Grimmer and L Bronisz 1979 8 p refs Presented at the 1979 Intern Solar Energy Soc Meeting, Atlanta, 28 May 1979  
(Contract W-7405-eng-36)  
(LA-UR-79-1335 Conf-790541-6) Avail NTIS HC A02/MF A01

The simulator design follows general construction guidelines, but modifications were necessary to insure a + or - 10% uniform flux over a 0.1 sq m area Considerable adjustments were necessary to achieve desired performance for the testing of collector modules and materials These adjustments and details of simulator construction including design schematics and simulator mounting, are described Also presented are flux maps for the twelve lamp array Finally, construction materials costs are discussed for this inexpensive solar simulator suitable for many-testing applications  
DOE

**N79-32717#** Energy Resources Co, Inc Cambridge, Mass  
**POTENTIAL USE OF WOOD AND AGRICULTURE WASTES AS STEAM GENERATOR FUEL FOR THERMAL ENHANCED OIL RECOVERY** Final Report  
Herbert M Kosstrin and Roy K McDonald May 1979 32 p refs  
(Contract EW-78-X-03-1038)  
(SAN-1038-PO-1) Avail NTIS HC A03/MF A01

The potential to use wood and agriculture wastes to replace crude oil as steam generator fuel was evaluated California's San Joaquin Valley was the focus for the study The production of waste materials by county, estimated energy value of each material and estimated transportation cost for each material are documented Both agriculture and wood wastes were found to be available in sizeable quantities and could become attractive steam generation fuels However some qualifications need to be made on the use of these materials Transportation costs will probably limit the range of shipping these materials to perhaps 50 to 100 miles Availability is subject to competition from existing and developing uses of these materials such as energy sources in their immediate production area Existing steam generators probably cannot be retrofitted to burn these materials Fluidized bed combustion, or low Btu gasification, may be a good technology for utilization  
DOE

**N79-32718#** Brookhaven National Lab Upton, N Y Medical Dept  
**AVOIDING FUTURE HEALTH PROBLEMS RELATED TO SOLAR ENERGY (PHOTOVOLTAIC) TECHNOLOGY**  
Louis V Stang 4 Apr 1979 25 p refs Presented at the Conf on Health Implications of the New Energy Technol Park City Utah, 4 Apr 1979  
(Contract EY-76-C-02-0016)  
(BNL-25935 Conf-790447-1) Avail NTIS HC A02/MF A01

The hazards involved in disposing of solar cells at the end of their service life are discussed Several chemical elements

that are likely candidates for photovoltaic development are enumerated. The present state of knowledge concerning their toxicities are commented on briefly, and studies that should be undertaken in the near future to provide adequate information on these toxicities are suggested. DOE

**N79-32719#** Sandia Labs., Albuquerque, N Mex

#### AVAILABILITY OF WIND POWER

J W Reed 1978 15 p refs Presented at Seminar on Wind Energy for Electrical Generation, Recife, Brazil, 13-16 Feb 1978

(Contract EY-76-C-04-0789)

(SAND-78-0548C Conf-780253-1) Avail NTIS HC A02/MF A01

Meteorological studies of available wind power to support the development of a vertical-axis wind turbine are presented and reviewed. Climatological studies that are needed to assist and promote wind energy exploitation in Brazil are summarized. DOE

**N79-32720#** Sandia Labs., Livermore, Calif

#### RECENT ADVANCES IN THERMOCHEMICAL ENERGY STORAGE AND TRANSPORT

T T Bramlette 1978 7 p refs Presented at 13th Intersoc Energy Conversion Eng Conf., San Diego, Calif, 20 Aug 1978 (Contract EY-76-C-04-0789)

(SAND-78-8505, Conf-780801-22) Avail NTIS HC A02/MF A01

The potential role of thermal storage systems based on reversible chemical reactions was investigated for both solar and nonsolar utilities. System studies are described for those based on the more promising chemical reactions which utilize calcium hydroxide, sulfur trioxide, and ammonium hydrogen sulfate. Chemical heat pipes and heat pump storage projects using sulfuric acid methanolates are also examined. DOE

**N79-32721#** Department of Energy, Oak Ridge, Tenn. Technical Information Center

#### ENERGY INFORMATION DATA BASE. SERIAL TITLES

Jun 1978 40 p

(TID-4579-R-10-Suppl-1) Avail NTIS HC A03/MF A01

This supplement contains changes and additions to TID-4579-R10 and is intended to be used with that publication. DOE

**N79-32722#** Brookhaven National Lab., Upton, N Y

#### SYSTEMS FRAMEWORK FOR ENERGY ANALYSIS IN DEVELOPING COUNTRIES

Philip F Palmedo Oct 1978 18 p refs

(Contract EY-76-C-02-0016)

(BNL-25933) Avail NTIS HC A02/MF A01

Criteria that successful energy planning must meet are outlined and some ways to go about such planning are suggested. Distinction is made between energy planning and energy policy analysis. Some concerns in national energy planning and policymaking considered are energy investment decisions, pricing policy, energy conservation policy, research and development policy, broad energy policies and strategies, and economic and social development planning. DOE

**N79-32723#** Department of Energy, Washington, D C Energy Information Administration

#### ENERGY EMERGENCY MANAGEMENT INFORMATION SYSTEM (EEMIS). PROGRAM PLAN

Mar 1979 123 p

(DOE/EIA-0135) Avail NTIS HC A06/MF A01

The energy emergency management information system (EEMIS) program is described. EEMIS will be called upon to provide information to users as soon as fuel supply/demand imbalances are anticipated. Potential causes of fuel shortages where EEMIS would respond to are sudden decreases in petroleum imports, gaseous fuel supplies, and petroleum production in the US, regional transportation outages, sudden decrease in coal production in the US, unanticipated heavy regional demand, and disruption of power plant operations. DOE

**N79-32724#** West Virginia Univ., Morgantown Dept of Geology and Geography

#### IMPACTS OF THE RESOURCE CONSERVATION AND RECOVERY ACT ON THE SITING OF COAL-CONVERSION ENERGY FACILITIES IN THE UNITED STATES

Frank J Calzonetti Feb 1979 42 p refs

(Contract W-7405-Eng-26)

(ORNL/OEPA-12) Avail NTIS HC A03/MF A01

Facilities holding wastes that are sited at sandy locations are likely to have serious leachate contamination problems forcing the developer to take special precautions or use expensive pond liners, such as membranes. The Resource Conservation and Recovery Act may add to the attractiveness of using low-ash coals because the amount of wastes generated depends critically on the amount of noncombustible material in the coal and will probably decrease the attractiveness of urban locations for new energy facilities. Most facilities producing the largest volumes of heavy, inexpensive substances are to be located far from the traditional markets and off barge-scale, navigable rivers. Long-distance overland hauls of ash and sulfur are infeasible, so ways must be found to use them locally. Markets for sulfur are more regionally concentrated than those for ash. DOE

**N79-32725#** Oak Ridge National Lab., Tenn.

#### PROPOSED INDUSTRIAL ENERGY DATA BASE FOR TECHNICAL EVALUATION OF ALTERNATIVE ENERGY SYSTEMS

Richard W Barnes 1978 30 p Presented at the Workshop on Design of Ind Energy Inform Systems, Hilton Head Island, S C., 6 Dec 1978

(Contract W-7405-ENG-26)

(CONF-781244-1) Avail NTIS HC A03/MF A01

Energy information required by industrial managers to make effective decisions concerning (1) management of energy use and supply, (2) introduction of new energy technology, and (3) conversion to new manufacturing processes is discussed. Energy accounting and auditing systems, significant technological and economic factors, and the pertinent external (to the industrial user) variables are also discussed. DOE

**N79-32726#** Oak Ridge National Lab., Tenn

#### OVERVIEW OF WASTE HEAT UTILIZATION TECHNIQUES

Mitchell Olszewski Apr 1979 18 p refs Presented at Am Power Conf., Chicago, 23 Apr 1979

(Contract W-7405-eng-26)

(CONF-790443-2) Avail NTIS HC A02/MF A01

Cooling water from power plants is generally discharged in the range of 15 to 43 C (60 to 110 F) depending on the temperature of the available inlet water, quantity circulated, plant load, and heat-rejection system used. Possible uses for this low-grade heat include greenhouse horticulture, soil heating (both open field and in greenhouses), spray irrigation for frost protection, organic waste treatment (particularly for algae or biomass production), and aquaculture/mariculture. To date greenhouse and aquaculture/mariculture systems have received the most attention and have, therefore, progressed farthest. Several innovative techniques that utilize powerplant reject heat for these applications are described for the U.S., Canada, France, West Germany, and the USSR. DOE

**N79-32727#** California Univ., Livermore Lawrence Livermore Lab

#### ENERGY AND TECHNOLOGY REVIEW

Mar 1979 29 p refs

(Contract W-7405-eng-48)

(UCRL-52000-79-3) Avail NTIS HC A03/MF A01

A laser system that produces tunable, coherent beams of radiation covering the electromagnetic spectrum from below 200 nm in the ultraviolet to above 1000 nm in the infrared has been developed. The system uses a tunable dye laser in the visible region and converts the laser light to shorter and longer wavelength by stimulated Raman scattering in molecular hydrogen or deuterium gas. For example, in the ultraviolet region, wavelengths as short as 171.3 nm have been generated. Tunable ultraviolet beams can be applied to atomic and molecular spectroscopy as well as to isotopic and chemical analyses. DOE

**N79-32730#** Messerschmitt-Boelkow-Blohm G m b H, Otto-brunn (West Germany) Unternehmensbereich Raumfahrt  
**DEVELOPMENT OF A PROTOTYPE 10kW SOLAR POWER PLANT Final Report**

Dietmar Wolf, Herrmann Bihlmayr, Jochen Carl, Veit Merges, Peter Prikyrl, and Peter Vinz Bonn Bundesmin fuer Forsch u Technol Dec 1978 167 p refs In GERMAN, ENGLISH summary  
 (Contract BMFT-03E-4055-C/ETS-8000)  
 (BMFT-FB-T-78-33) Avail NTIS HC A08/MF A01 Fachinfor-mationszentrum, Eggenstein-Leopoldshafen, West Ger DM 34.90

A solar power plant built in the Federal Republic of Germany is described. The development of three other small plants for the generation of electricity from solar energy is also reported on. The design, installation, and commissioning of the plant and of the supporting systems are reviewed. Autonomous operation using technologies as simple as possible and components from series production is emphasized. During acceptance tests the specified maximum net electrical power output of 10 kW at a cooling water temperature of 35 C, the observance of the voltage and frequency tolerances for the generated current and partial load operation were successfully demonstrated. Further long term tests under real operation conditions are recommended.

Author (ESA)

**N79-32731#** National Aerospace Lab., Amsterdam (Netherlands)  
 Div of Fluid Dynamics

**INVESTIGATIONS ON THE AEROELASTIC STABILITY OF LARGE WIND TURBINES**

H H Ottens and R J Zwaan 10 Apr 1978 21 p refs  
 Presented at the 2d Intern Symp on Wind Energy Sys Amsterdam, 3-5 Oct 1978  
 (NPL-MP-78014-U) Avail NTIS HC A02/MF A01

The aeroelastic stability of wind turbines with vertical axis (VAWT) and with horizontal axis (HAWT) is discussed. Results are given for an existing 5 m VAWT test-bed with and without a tie-down system. Finally, difficulties are discussed in interpreting preliminary results for a horizontal axis wind turbine. Stability diagrams are shown.

Author (ESA)

**N79-32732#** MITEC G m b H, Ottobrunn (West Germany)  
**THE USE OF THE HEAT PUMPS TO RAISE TEMPERATURES IN AN ECONOMICAL AND ECOLOGICAL WAY Final Report, Jul 1977**

Max Huber and Fritz Bukau Bonn Bundesmin fuer Forsch u Technol Dec 1978 295 p refs  
 (Contract BMFT-03E-5211-A/ETS-0004-A)  
 (BMFT-FB-T-78-35) Avail NTIS HC A13/MF A01 Fachinfor-mationszentrum, Eggenstein-Leopoldshafen, West Ger DM 61.75

The use of heat pumps to transfer the cooling water from plant condensers to a hot water district heating system was investigated both from a thermodynamic and economic point of view. A model of the system was derived and evaluated in detail. The specific consumption of primary energy and the expected specific heat costs were determined depending on different parameters. Results show that if certain marginal conditions are presumed, such district heating system may be equivalent to or even better than conventional hot water district heating performed on the basis of combined power-heat generation.

Author (ESA)

**N79-32733#** Austrian Solar and Space Agency Vienna  
**METEOROLOGICAL DATA FOR SOLAR ENERGY APPLICATIONS**

M Bruck 1978 12 p refs  
 Avail NTIS HC A02/MF A01

Meteorological quantities and the mathematical techniques used for acquiring them are presented. Their relevance to solar energy utilization is emphasized. Following a discussion of the definitions of extraterrestrial solar radiation and terrestrial radiation (thermal radiation) meteorological radiation quantities are listed and a formula easily adaptable to a programmable pocket calculator for the calculation of the yearly variation in the global radiation incident on a horizontal plane is presented. Air

temperature, relative humidity and wind are also discussed as important meteorological parameters.

Author (ESA)

**N79-32734#** Polytechnic Inst of New York, Brooklyn  
**ASSESSMENT OF HYDROPOWER RESTORATION AND EXPANSION IN NEW YORK STATE, VOLUME 1**

R S Brown and A S Goodman Aug 1978 90 p Sponsored by the Power Authority of the State of New York and New York State Energy Research and Development Authority  
 (PB-295782/7 NYSEDA-78/6-Vol-1) Avail NTIS HC A05/MF A01 CSCL 10B

The study of the potential for the development of small scale hydropower indicates a potential of 3,000 megawatts of undeveloped capacity at a minimum of 754 sites in New York State. This figure far exceeds all previous estimates. The cost of such development will not be cheap but may well be competitive with new generating capacity either thermal or nuclear. Small hydropower has these added advantages: (1) this technology has the shortest time frame for implementation, (2) environmental impact will be minimal and (3) socioeconomic impact will be positive.

GRA

**N79-32735#** Office of Technology Assessment, Washington D C

**RENEWABLE OCEAN ENERGY SOURCES PART 2 WORKING PAPERS OCEAN WINDS, CURRENTS, WAVES, TIDES AND SALINITY GRADIENTS**

Mar 1979 153 p refs  
 (PB-295876/7) Avail NTIS HC A08/MF A01 CSCL 10B

Renewable ocean energy systems are described. Six ocean energy systems are presented. They are: ocean thermal energy conversion, tidal power generation, ocean winds for wind-powered generators, ocean waves for waterwave energy conversion, ocean currents, and salinity gradients. The relative potential for contributing to future energy supplies and the state of advancement are assessed.

A W H

**N79-32736#** New Mexico Energy Inst, Albuquerque  
**THEORETICAL ANALYSIS OF A PASSIVE HEAT PIPE HEATING AND COOL SYSTEM**

K T Feldman Dec 1978 46 p refs Sponsored in part by N Mex Energy and Minerals Dept Santa Fe  
 (PB-296066/4 NMEI-23/SA) Avail NTIS HC A03/MF A01 CSCL 13A

A totally new concept which combines both a heat pipe and a flat plate solar collector for daytime solar water heating and nighttime water cooling was studied theoretically. Since the heat pipe is a passive heat transfer device, the entire system requires no pumps or auxiliary power for its operation. This makes the system reliable and should require very little maintenance. This system with a collector area of 400 sq ft can meet both winter space heating and summer space cooling requirements. For a typical winter day it can provide about 8000 lbs/day of hot water at 140 F or about 530,000 Btu/day. For a summer day it can provide about 4000 lbs/day of chilled water at 45 F or about 100,000 Btu/day for space cooling.

GRA

**N79-32737#** Joint Center for Graduate Study Richland Wash  
**INVESTIGATION OF LOW COST SOLAR CELLS BASED ON Cu<sub>2</sub>O Annual Progress Report, 1 Oct 1975 - 30 Sep 1976**

Larry C Olsen 30 Sep 1976 91 p refs  
 (Grant NSF AER-75-20501)  
 (PB-295888/2 NSF/RANN/AER-75-20501/PR/76/3  
 NSF/RA-761743) Avail NTIS HC A05/MF A01 CSCL 10B

Fabrication of thin-film backwall Cu/Cu<sub>2</sub>O cells, collection efficiency measurements and analysis, MIS solar cell theory and initiation of frontwall solar cell studies are discussed. A system was established for controlled oxidation of copper. Both thick film and thin film backwall cells were fabricated and characterized. These cells typically have J about 0.00003 A/sq cm and n 3.5. Analysis of thick film diodes suggest that a high interface state density exists at the Cu-Cu<sub>2</sub>O junction. The thin film cells have very low shunt resistances due to the granular structure. Spectral collection efficiency of thin film backwall cells was measured to be 25 percent at 600 nm. Assuming a reasonable collection

efficiency for backwall cells, the upper limit of performance for backwall cells is projected to be 4 percent GRA

**N79-32738#** National Bureau of Standards Washington, D C  
Center for Building Technology  
**HUD UTILITIES DEMONSTRATION SERIES. VOLUME 9-  
DESCRIPTION OF THE DATA ACQUISITION AND INSTRUMENTATION SYSTEMS, JERSEY CITY TOTAL ENERGY PROJECT**

Charles Bulik, William G Rippey, C Warren Hurley, and Daniel E Rorrer Mar 1979 161 p refs Sponsored in part by HUD (PB-294926/1, NBSIR-79-1709) Avail NTIS HC A08/MF A01 CSCL 13A

The design and operation of the instrumentation system and the data acquisition system used to monitor the total energy plant and certain utility services to the site buildings are described. A description of the types, characteristics, and locations of instruments used to measure physical variables is given. The capabilities and operational modes of the data acquisition system components are described in detail. A description of the total energy plant and site, instrument costs, data processing procedures and some of the instrumentation problems encountered is presented GRA

**N79-32739#** Applied Physics Lab., Johns Hopkins Univ Laurel, Md

**ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LAB. Quarterly Report, Oct. - Dec 1978**

W J Toth, K Yu, F C Paddison, R S P Weissbrod, and C S Leffel, Jr Jan 1979 46 p refs Sponsored in part by DOE Wash, D C (PB-295439/4, APL/JHU/EQR-78/4) Avail NTIS HC A03/MF A01 CSCL 10A

Progress in developing energy resources utilization concepts, and storage methods is reported. Energy technology areas discussed include (1) geothermal energy marketing and development in the Delmarva region of Maryland, (2) redevelopment of dams for small-scale hydroelectric energy projects, (3) ocean engineering and heat exchangers for ocean thermal energy conversion and (4) flywheels and heat pumps for energy conservation and storage K L

**N79-32746#** Department of Energy Washington D C  
**ENVIRONMENTAL DEVELOPMENT PLAN, FOSSIL FUEL UTILIZATION PROGRAM**

Apr 1979 101 p refs (DOE/EDP-0046) Avail NTIS HC A06/MF A01

A common basis for planning, managing and reviewing all environmental aspects of the energy programs under DOE's jurisdiction is provided by environmental development plans (EDP) which identify the environmental concerns and research and development necessary for assessing the potential environmental impacts and mitigating measures associated with an energy technology. To ensure that environmental health, and safety (EH&S) considerations will be addressed adequately in the technology decision making process, the EDP (1) identifies and evaluates EH&S concerns, (2) defines EH&S research and related assessments to examine or resolve the concerns, (3) provides a coordinated schedule with the technology program for required EH&S research and development, and (4) indicates the timing for environmental assessments, environmental impact statements, environmental readiness documents, and safety analysis reports. DOE

**N79-32747#** Water Purification Associates, Cambridge Mass  
**WATER RELATED ENVIRONMENTAL EFFECTS IN FUEL CONVERSION 1 SUMMARY VOLUME**

H Gold and D J Goldstein 1978 259 p refs (Contract EX-76-C-01-2445)

(FE-2445-1-Vol-1) Avail NTIS HC A12/MF A01

Effects that could be expected from siting specific conversion plants at given locations in the major coal and oil shale bearing regions of the United States were investigated. The synthetic fuel technologies examined include coal gasification to convert coal to pipeline gas, coal liquefaction to convert coal

to low sulfur fuel oil, coal refining to produce a de-ashed low sulfur solvent refined (clean) coal, and oil shale retorting to produce synthetic crude. The results presented include the range of water requirements, the conditions for narrowing the range and optimizing the use of water, the ranges of residual solid wastes, and the cost and energy requirements for wastewater treatment. Water resources data in the coal and oil shale regions were assessed. Potential water supply sources for each site were evaluated in terms of the available water supply. The degree of wet cooling used to dissipate waste heat was determined on the basis of water availability and cost DOE

**N79-32751#** Saarbergwerke A G Saarbrueken (West Germany)  
Hauptabt Forschung und Entwicklung Umweltschutz  
**ENGINEERING STUDY OF THE FLUE GAS DESULFURIZATION UNIT FOR THE POWER PLANT WEIHER 3 Final Report, Jun 1977**

Friedrich Hofmann, Heinrich Igelbuescher and Gerhard Scholl Bonn Bundesmin fuer Forsch u Technol Dec 1978 55 p refs In GERMAN ENGLISH summary (Contract BMFT-03E-1012/ETS-6000-A) (BMFT-FB-T-78-28) Avail NTIS HC A04/MF A01 Fachinformationszentrum, Eggenstein-Leopoldshafen West Ger DM 11,35

Following the experience gathered during operation of the test facility for flue gas desulfurization at the Weiher 2 power station, the possible construction of a fullscale plant was examined. Results show that with a few exceptions the successful concept of Weiher 2 can be retained as well as the equipment and aggregates used there. The technology transfer of the experience gathered at the test facility for a flue gas throughput of 125,000 cu m/hr to the projected plant is shown to be feasible. In individual cases improvements are possible regarding the equipment and aggregates. For example the installation of the fan (now preceding the plant) or the general use of shallow bottoms for the tanks instead of hopper gates is discussed. Author (ESA)

**N79-32811#** Sandia Labs, Albuquerque, N Mex  
**WIND POWER CLIMATOLOGY OF THE UNITED STATES, SUPPLEMENT**

Jack W Reed Apr 1979 85 p refs

(Contract AC-04-76-DP-00789) (SAND-78-1620) Avail NTIS HC A05/MF A01

The summaries in the earlier Wind Power Climatology of the United States are extended to include monthly and annual average wind speeds. Station histories that allow adjustment for local air density based on station pressure-altitude and the annual temperature cycle, were obtained from the National Climatic Center. The logs of anemometer exposures were used to adjust both wind speeds and wind powers to standard height, 10 m above ground. Extrapolations for speed and power at 20- and 50-m heights are also provided. DOE

**N79-32995#** Battelle Pacific Northwest Labs Richland, Wash  
**SUMMARY OF NATIONAL AND INTERNATIONAL RADIOACTIVE WASTE MANAGEMENT PROGRAMS**

K M Harmon Mar 1979 94 p

(Contract EY-76-C-06-1830) (PNL-2941) Avail NTIS HC A05/MF A01

The status of fuel cycle and waste management programs is described for Argentina, Australia, Austria, Belgium, Brazil, Canada, China, Denmark, Finland, France, Democratic Republic of Germany, Federal Republic of Germany, India, Italy, Japan, Mexico, the Netherlands, Pakistan, Spain, Sweden, Switzerland, United Kingdom, United States and USSR. This compilation attempts to provide current information as of the end of January 1979. DOE

**N79-33036#** Florida Univ., Gainesville Dept of Engineering Sciences

**HARTMANN FLOWS IN THE MHD GENERATOR CONFIGURATION**

Rush E Elkins III, Thomas A Trovillion, and E Rune Lindgren Jun 1979 60 p refs



(Contract N00014-76-C-0410)  
(AD-A070080, TR-01-002) Avail NTIS HC A04/MF A01  
CSCL 20/9

Specific features and characteristics of Hartmann flows in the Faraday generator configuration are reported. These features concern the effect of longitudinal baffling along the insulating duct walls, effects of slip between gas-liquid phases in the flow. The report also contains an analysis of a compensating system of a Faraday generator as well as a one-dimensional zero-slip model of a two-phase MHD flow through the generator. GRA

**N79-33042#** STD Research Corp., Arcadia, Calif.  
**MAGNETOGASDYNAMIC PHENOMENA IN PULSED MHD FLOWS** Interim Summary Report, 1 Aug 1977 - 31 Oct. 1978

S T Demetriades, D M Markham, C D Maxwell, D A Oliver, and T F Swaan Jan 1978 66 p refs  
(Contract N00014-77-C-0574)  
(AD-A070590, STD-UP-002-77-1, STDR-79-2) Avail NTIS HC A04/MF A01 CSCL 20/9

This report examines some of the detailed structure of magnetogasdynamic flows encountered in pulsed magnetohydrodynamic (MHD) generators. Two illustrations of magnetogasdynamic nonuniformities are considered. The first is for conventional explosive-driven MHD generators. Here we reveal the detailed structure of the deceleration of the conducting slug formed by the compression of plasma between the explosive-driven shock wave and its following contact surface. The second illustration is for steady high Magnetic Reynolds Number channel flows. Here we exhibit the nonuniform manner in which the external magnetic field is diffused into the plasma and the corresponding nonuniform deceleration of the flow. GRA

**N79-33096#** Brown Univ., Providence, R I Div of Engineering

**THERMODYNAMIC AND TRANSPORT PROPERTIES OF ISOBUTANE: A SURVEY OF AVAILABLE DATA**

J Kestin, H E Khalifa, and B Kumar Nov 1978 204 p refs  
(Contract EY-76-S-02-4051)  
(COO-4051-35, CATMEC/27) Avail NTIS HC A10/MF A01

An extensive compilation of the available equilibrium and transport properties of isobutane (2-methyl propane) is presented. Also, the available correlations of the thermodynamic properties of isobutane are listed, the statement is made that these correlations do not agree among themselves, and that none is obviously superior to the others. The compilation of available experimental data on equilibrium properties (up to 1978) is preparatory step towards the formulation of a new, more accurate correlation as an aid for design of geothermal installations. DOE

**N79-33107#** Raytheon Co., Burlington, Mass.  
**TRANSPORTATION SYSTEMS CENTER BIBLIOGRAPHY OF TECHNICAL REPORTS**

Janice A Bilsback Mar 1979 133 p  
(PB-298342/9, DOT-TSC-RSPA-79-5) Avail NTIS HC A07/MF A01 CSCL 01C

The bibliography lists unlimited distribution reports released by the Transportation Systems Center from January through December 1978. It supplements the Transportation Systems Center Bibliography of Technical Reports, July 1970 - December 1976 (DOT-TSC-OST-77-17) and January - December 1977 (DOT-TSC-OST-78-14). Reports are listed by sponsoring agency, and are indexed by subject, personal author, corporate author, title, contract number and report number. GRA

**N79-33115#** Executive Office of the President, Washington, D C  
**AERONAUTICS AND SPACE REPORT OF THE PRESIDENT, 1978 ACTIVITIES**

Jimmy Carter NASA Jul 1979 109 p  
Avail NTIS MF A01, SOD HC as NAS1 52 978

Highlights of national aeronautics and space programs for the year are described for the following areas: communications,

Earth resources, space science, transportation, and space energy. Activities of NASA and five other Federal agencies with the largest programs in these areas are discussed. The national space policy statement is included in the appendixes along with records of U S spacecraft launchings, the history of U S and Soviet manned space flights, and data related to applications satellites, scientific payloads, and space probes. Budgetary summaries are included. A R H

**N79-33151#** Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e V., Karlsruhe (West Germany) Inst fuer Systemtechnik und Innovationsforschung  
**PUBLISHED PATENT APPLICATIONS AND PATENTS RESULTING FROM GERMAN GOVERNMENT SPONSORED RESEARCH AND DEVELOPMENT Final Report**

Gerhard Jaeckel and Ingrid Zierl Bonn Bundesmin fuer Forschung u Technol Dec 1978 112 p In GERMAN, ENGLISH summary  
(Contract BMFT-NT-0442)  
(BMFT-FB-T-78-31) Avail NTIS HC A06/MF A01, Fachinformationszentrum, Eggenstein-Leopoldshafen, West Ger DM 23,55

The ministry for Research and Technology of the Federal Republic of Germany has sponsored research and development related to industrial innovations since 1969. Work reported on includes the published patent applications and patents from all projects which were sponsored up to and including 1974. Fields covered are electronics, optics, nonnuclear energy technology, applications of pure physics, materials development, and industrial processes technology. Author (ESA)

**N79-33158** West Virginia Univ., Morgantown  
**A FREE-VORTEX MODEL WITH NUMERICAL SOLUTION FOR THE UNSTEADY LIFTING CHARACTERISTICS OF STRAIGHT BLADED DARRIEUS WIND TURBINES** Ph D. Thesis

Paul Gerald Migliore 1979 295 p  
Avail Univ Microfilms Order No 7920716

A method was developed to analyze the flow and predict the lifting characteristics of vertical axis wind turbines. Blades are modeled by a number of discrete bound vortices located on the airfoil mean camber line, the wake is modeled by a number of discrete vortices shed from the blade trailing edge. Application of the flow tangency boundary condition and the Kutta condition permit a numerical solution for the strengths of the bound vortices. Blade forces are then determined from potential theory. This vortex model faithfully reflects the important phenomena of flow unsteadiness and wake/blade interaction. Wake details and energy extraction efficiency are analyzed for single and multi-bladed turbines. A comparison of experimental data to analytical predictions shows close agreement for the maximum power coefficient and the tip speed ratio at which it occurs. Dissert Abstr

**N79-33207\*#** Lockheed-California Co., Burbank  
**STUDY OF THE APPLICATION OF HYDROGEN FUEL TO LONG-RANGE SUBSONIC TRANSPORT AIRCRAFT. VOLUME 1: SUMMARY Final Report**

G D Brewer, R E Morris, R H Lange, and J W Moore Jan 1975 56 p refs For vol 2 see N75-30163  
(Contract NAS1-12972)  
(NASA-CR-132558, LR-26752-1) Avail NTIS HC A04/MF A01 CSCL 21E

The feasibility of using liquid hydrogen as fuel in advanced designs of long range, subsonic transport aircraft is assessed. Both passenger and cargo type aircraft are investigated. Comparisons of physical, performance, and economic parameters of the LH2 fueled designs with conventionally fueled aircraft are presented. Design studies are conducted to determine appropriate characteristics for the hydrogen related systems required on board the aircraft. These studies included consideration of material, structural, and thermodynamic requirements of the cryogenic fuel tanks and fuel systems with the structural support and thermal protection systems. A W H

**N79-33211#** Monsanto Research Corp., Dayton Ohio  
**RECLAMATION OF SYNTHETIC TURBINE ENGINE OIL MIXTURES** Final Report, 15 Mar. 1976 - 15 Mar 1978  
 Gerald Glasgow and Richard J. Bruns Apr 1979 179 p refs  
 (Contract F33615-76-C-2037, AF Proj 3048)  
 (AD-A071813 MRC-DA-780, AFAPL-TR-78-50) Avail NTIS  
 HC A09/MF A01 CSCL 11/8

The objective of this program was to develop a technique for reclaiming used synthetic turbine engine oil mixtures and to demonstrate the technical feasibility of the developed reclamation technique by restoring a limited number of used MIL-L-7808 oils to a satisfactory performance level. Reclamation process studies based on approaches utilized by the natural oil and fat refining industry resulted in the development of a reclamation process applicable to synthetic ester turbine engine oils. The components of a reclamation process applicable to a broad range of used MIL 7808G oil mixtures were defined and the technical feasibility established by reclamation and evaluation (via qualification tests) of two batches of used oils. Recommendations for improvement and refinement of the process and approaches to more extensive documentation of its viability were made. GRA

**N79-33253\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**REDUCED POWER PROCESSOR REQUIREMENTS FOR THE 30-cm DIAMETER Hg ION THRUSTER**  
 Vincent K. Rawlin 1979 14 p refs Presented at the 14th Intern Conf on Electric Propulsion Princeton N.J., 30 Oct - 1 Nov 1979 sponsored by AIAA and Deutsche Gesellschaft fuer Luft- und Raumfahrt  
 (NASA-TM-79257 E-169, AIAA-Paper-79-2081) Avail NTIS  
 HC A02/MF A01 CSCL 21C

An evaluation of simplifications for the thruster power processor interface for a 30 cm Hg ion thruster is presented. Tests on the engine thruster control and the power supplies are performed. Reduced power processor requirements are defined and the impact on thruster design, performance and lifetime are assessed. AWH

**N79-33336\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**JET FUEL THERMAL STABILITY**  
 William F. Taylor ed (Exxon Research and Engineering Co., Linden, N.J.) 1979 158 p Workshop held at Cleveland, 1-2 Nov 1978  
 (NASA-TM-79231) Avail NTIS HC A08/MF A01 CSCL 21D

Various aspects of the thermal stability problem associated with the use of broadened-specification and nonpetroleum-derived turbine fuels are addressed. The state of the art is reviewed and the status of the research being conducted at various laboratories is presented. Discussions among representatives from universities, refineries, engine and airframe manufacturers, airlines, the Government, and others are presented along with conclusions and both broad and specific recommendations for future stability research and development. It is concluded that significant additional effort is required to cope with the fuel stability problems which will be associated with the potentially poorer quality fuels of the future such as broadened specification petroleum fuels or fuels produced from synthetic sources. ARH

**N79-33340#** Institute of Gas Technology, Chicago, Ill  
**DEVELOPMENT OF COMBUSTION DATA TO UTILIZE LOW-Btu GASES AS INDUSTRIAL PROCESS FUELS. FLAT-FLAME BURNER**  
 Richard T. Waibel and Edward S. Fleming Dec 1978 30 p refs  
 (Contract EX-76-C-01-2489, Proj 61004)  
 (FE-2489-36 Special-Report-5) Avail NTIS HC A03/MF A01

Eight types of industrial burners were tested using three different low- and medium-Btu gases. The performance of each burner with these gases was compared to its performance with natural gas in terms of flame stability and shape, furnace efficiency, heat absorption profile, noise level, temperature profiles, radiant heat flux, post-flame emissivity and flow direction. DOE

**N79-33341#** National Technical Information Service, Springfield Va  
**ALCOHOL FUELS CITATIONS FROM THE ENGINEERING INDEX DATA BASE** Progress Report, 1970 - Jun 1979  
 Diane M. Cavagnaro Jul 1979 247 p Supersedes NTIS/PS-78/0674 and NTIS/PS-77/0621  
 (NTIS/PS-79/0714/0, NTIS/PS-78/0674, NTIS/PS-77/0621)  
 Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Reports from a worldwide literature survey discuss new technology in the field of alcohol fuels. The different blends, synthesis, processes used, properties, engine performance evaluations, economics, safety measures, pollution effects, and combustion studies are covered. Sources from which alcohol fuels can be obtained, such as coal, solid wastes, industrial by-products, and agricultural wastes are reported. Two hundred and forty-one abstracts, 50 of which are new entries to the previous edition are presented. GRA

**N79-33342#** National Technical Information Service, Springfield, Va  
**ALCOHOL FUELS, VOLUME 2 CITATIONS FROM THE NTIS DATA BASE** Progress Report, 1978 - Jun 1979  
 Diane M. Cavagnaro Jul 1979 144 p Supersedes NTIS/PS-78/0673 and NTIS/PS-77/0620  
 (NTIS/PS-79/0713/2, NTIS/PS-78/0673, NTIS/PS-77/0620)  
 Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Federally-funded research on alcohol based fuels that may be used in the future as a fuel source is presented. Synthesis, chemical analysis, performance testing, processing, pollution, economics, environmental effects, and feasibility are included. One hundred and thirty-five abstracts, 109 of which are new entries to the previous edition are reported. GRA

**N79-33343#** National Technical Information Service, Springfield, Va  
**ALCOHOL FUELS, VOLUME 1 CITATIONS FROM THE NTIS DATA BASE** Progress Report, 1964 - 1977  
 Diane M. Cavagnaro Jul 1979 170 p  
 (NTIS/PS-79/0712/4) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Reports from Federally-funded research are cited covering chemical analysis, performance testing, synthesis, processing, pollution, economics, environmental effect, and feasibility. (This updated bibliography contains 161 abstracts, none of which is new to the previous edition.) GRA

**N79-33344#** Gulf Research and Development Co., Chestwick, Pa  
**INVESTIGATION OF MECHANISM OF REACTIONS INVOLVING OXYGEN-CONTAINING COMPOUNDS IN COAL HYDROGENATION** Final Report, Mar 1979  
 D. C. Cronauer and R. G. Ruberto Mar 1979 245 p refs  
 Prepared for EPRI  
 (EPRI Proj 713-1)  
 (EPRI-AF-913) Avail NTIS HC A11/MF A01

Reactions involving oxygen during hydrogenative liquefaction are presented as well as the establishment of a kinetic model to describe coal liquefaction. Emphasis was directed toward the liquefaction of Belle Ayr subbituminous coal with subsequent test runs made with Burning Star bituminous coal. The liquefaction experiments were made in a CFSTR bench-scale unit operated at temperatures between 400 and 470 C, space times between 5 and 60 minutes and a fixed total pressure of 2000 psig. It was shown that between 70% and 85% of the coal organic oxygen is removed as carbon oxides and water. Carboxylic, carbonylic, and etheric functionalities of coal are essentially removed during the liquefaction reaction. The most abundant oxygen-containing group in the reaction product is hydroxylic, a portion of which is necessarily formed by a reduction of other groups. The results of liquefying Belle Ayr coal were correlated by a kinetic model. DOE

**N79-33345#** General Accounting Office, Washington, D.C.  
 Energy and Minerals Div  
**THE POTENTIAL FOR HYDROGEN AS AN ENERGY SOURCE**  
 20 Apr 1979 16 p

(PB-295317/2 EMD-79-58) Avail NTIS HC A02/MF A01  
CSCL 21D

GAO surveyed a portion of the literature on the status, progress and problems surrounding the development and commercialization of hydrogen as an energy source GRA

**N79-33346#** Columbia Univ New York Dept of Chemical Engineering and Applied Chemistry  
**ETHANOLIC FUELS FROM RENEWABLE RESOURCES IN THE SOLAR AGE**

Harry P Gregor and Thomas W Jeffries 1979 34 p refs  
(PB-295645/6) Avail NTIS HC A03/MF A01 CSCL 21D

Production of ethanol, other liquid fuels, and organic chemicals from cellulosic biomass at prices that can compete with those of petroleum derived materials by employing presently available or soon to be developed membrane technologies is described. Contemporary membrane technologies can already effect major savings in process costs for the conventional fermentation of grains or molasses to produce ethanol, developing membrane technologies could employ cheap cellulosic substrates for ethanol production GRA

**N79-33347#** National Technical Information Service Springfield Va  
**HYDROGEN USE AS A FUEL. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jun 1979**

Audrey S Hundemann Aug 1979 191 p Supersedes NTIS/PS-78/0635, NTIS/PS-77/0522, NTIS/PS-76/0458  
(NTIS/PS-79/0779/3, NTIS/PS-78/0635, NTIS/PS-77/0522, NTIS/PS-76/0458) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Federally-funded research studies pertaining to the technical feasibility of using hydrogen as a fuel for vehicular transportation, electric power generation, and both subsonic and supersonic aircraft are discussed. One hundred and eighty six abstracts 24 of which are new entries to the previous edition are reported GRA

**N79-33348#** Michigan Univ Ann Arbor Dept of Chemical Engineering

**PHYSICAL PROPERTIES AND STABILITY OF WATER IN FUEL OIL EMULSIONS Final Report, Aug 1977 - Aug 1978**

H S Fogler, S R Reddy, M L Storbeck, J B Cross and S C Siegmund Mar 1979 121 p refs  
(Contract DOT-OS-70056)  
(PB-296146/4, UMICH-015657, DOT/RSPD/DPB/50-78/17) Avail NTIS HC A06/MF A01 CSCL 07D

The physical properties of water-in-fuel oil emulsions were investigated. Ultrasonically induced cavitation was used to produce emulsions in gasoline, No 2 diesel oil, No 4 heating oil, and No 6 fuel oil without the use of surfactants. Density and viscosity measurements for each of the four fuels used are presented for various temperatures in the range from 20C to 90C. Interfacial tension measurements, against water for each of the four fuels used are presented for temperatures in the range from 30C to 79C. The stability of water-in-fuel oil emulsions was also studied. A scanning electron microscope and a spectrophotometer were used to study the aging of oil-in-water emulsions, while water-in-oil emulsions were studied using a creaming cell GRA

**N79-33349#** General Accounting Office Washington, D C Energy and Minerals Div

**THE UNITED STATES REFINING POLICY IN A CHANGING WORLD OIL ENVIRONMENT Report to the Congress**

29 Jun 1979 35 p refs  
(PB-297136/4, EMD-79-59) Avail NTIS HC A03/MF A01 CSCL 21D

The implications of international and domestic factors affecting the United States refining industry are addressed. This report considers such matters as the control of domestic crude price under The Entitlement Program, the small refinery bias, the availability of domestic and imported crude supplies, environmental and other regulations, and other factors affecting refinery capacity issues. Producer-nation control of crude supplies, foreign refining

capacity and supplier-nation downstream developments are also addressed GRA

**N79-33352#** Stearns-Roger Corp Denver Colo  
**ECONOMIC EVALUATION OF FABRIC FILTRATION VERSUS ELECTROSTATIC PRECIPITATION FOR ULTRA-HIGH PARTICULATE COLLECTION EFFICIENCY Final Report**

S D Severson F A Horney D S Ensor (Meteorology Res Inc) and G R Markowski (Meteorology Res Inc) Jun 1978 137 p refs Sponsored by Elec Power Res Inst (EPRI Proj 834-1)

(EPRI-FP-775) Avail NTIS HC A07/MF A01

The economic selection in each case described was dependent on the particulate emission limit to be met, the physical and chemical characteristics of the coal and fly ash and the bag replacement schedule of the fabric filter. For systems designed to meet the Federal particulate emission limitation of 0.1 lb/10 to the 6th power BTU, the electrostatic precipitator had a clear advantage in one of the four cases. For systems designed to meet the more stringent New Mexico regulations, the fabric filter had a significant economic advantage in three of the four cases. If designs are based on obtaining a clear stack plume, the fabric filter has a significant advantage. Precipitator costs increase significantly as collection efficiency requirements are increased. Baghouse costs on the other hand remain essentially constant due to their inherently high collection efficiency. Baghouses become the economic choice for all coals even low-resistivity eastern ones, when permissible emission levels drop much below the current NSPS of 0.1 lb/10 to the 6th power BTU DOE

**N79-33518\*#** Geological Survey, Denver, Colo Petrophysics and Remote Sensing Branch

**GEOLOGIC APPLICATIONS OF THERMAL-INERTIA MAPPING FROM SATELLITE Progress Report, 1 Mar - 31 May 1979**

Terry W Offield Principal Investigator Susanne H Miller and Kenneth Watson May 1979 6 p Sponsored by NASA ERTS (E79-10279, NASA-CR-162144) Avail NTIS HC A02/MF A01 CSCL 08B

The author has identified the following significant results. After digitization, a noise rejection filter was applied to data obtained by USGS aircraft. An albedo image was formed by combining three bands of visible data. Along with the day and nighttime thermal data, the albedo image was used to construct a relative thermal-inertia image. This image, registered to a topographic base, shows there are thermal property differences in the vicinity of the contact between the Fort Union and Wasatch formations in the Powder River Basin, Wyoming.

**N79-33526\*#** Bureau de Recherches Geologiques et Minieres, Orleans (France)

**SPATIAL THERMAL RADIOMETRY CONTRIBUTION TO THE MASSIF ARMORICAIN AND THE MASSIF CENTRAL (FRANCE) LITHO-STRUCTURAL STUDY Progress Report, Apr. - Aug. 1979**

Jean-Yves Scanvic, Principal Investigator Sep 1979 28 p refs Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S D 57198 ERTS (E79-10294, NASA-CR-162325 Rept-1) Avail NTIS HC A03/MF A01 CSCL 08G

**N79-33538#** Denver Research Inst., Colo  
**EPA PROGRAM STATUS REPORT: OIL SHALE, 1979 UPDATE**

R E Pressey and P A Westcott Mar 1979 71 p refs (Contract EPA-R-806156)  
(PB-294998/0, EPA-600/7-79-089) Avail NTIS HC A04/MF A01 CSCL 08I

EPA studies related to the development and commercialization of oil shale are providing information on health and ecological effects from pollutants created by the extraction and processing of oil shale, and on technological methods that can be used to control the release of those pollutants. The program is also assessing the environmental impact of the use of the fuels refined from shale oil. The reader with an overview of current oil shale research and development (R and D) efforts being performed by EPA, or being funded by EPA monies passed through to other Federal agencies, under the five-year old 17 agency Interagency Energy Environment R and D Program. It covers extraction and handling, processing, energy-related processes and effects, and overall assessments. Project title, sponsoring agency, performing organization, project duration, and project contact are given.

GRA

**N79-33549#** Golder Associates, Inc., Kirkland, Wash  
**OIL MINING. A TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF OIL PRODUCTION BY MINING METHODS** Open File Report, Apr 1977 - Jul 1978

Anthony Edey, Bruce A Kennedy, and Leigh A Readdy Oct 1978 293 p refs

(Contract DI-BM-JO-275018)

(PB-297134/9, BM-OFR-55-79) Avail NTIS HC A13/MF A01 CSCL 081

The characteristics of oil fields which would make them amenable to mining techniques were identified. An inventory of known U S oil fields that offer this potential was collated. Data was then divided into fields having potential for underground and surface mining systems development. Several candidate fields in Arkansas, California, and Utah that fit particular underground and surface mining system types were selected. Conceptual mining systems were designed for the selected fields. Five underground and four surface methods were chosen. Costs of oil production were estimated for these selections. The impact of oil mining on the environment was also considered.

GRA

**N79-33562#** TRW Energy Systems, Redondo Beach, Calif  
**TECHNOLOGY OVERVIEW REPORTS FOR EIGHT SHALE OIL RECOVERY PROCESSES**

C C Shih, J E Cotter, C H Prien and T D Nevens Mar 1979 115 p refs Prepared in cooperation with Denver Research Inst., Colo

(Contract EPA-68-02-1881)

(PB-295665/4, EPA-600/7-79-075) Avail NTIS HC A06/MF A01 CSCL 081

Information for the evaluation of environmental impacts and pollution control technologies in connection with oil shale development is presented. General process descriptions, shale preparation requirements, equipment types, operating conditions, and process products and byproducts are reported. The physical and chemical characteristics of shale oil recovery, the energy and water requirements, the waste disposal, and site specific environmental aspects are examined.

A W H

**N79-33563#** California Univ., Riverside Institute of Geophysics and Planetary Physics

**TELLURIC SOUNDING AND MAPPING IN THE VICINITY OF THE SALTON SEA GEOTHERMAL AREA, IMPERIAL VALLEY, CALIFORNIA** M S Thesis

Eugene Drake Humphreys Jun 1978 127 p refs

(Grant NSF AER-72-03551)

(PB-296081/3, UCR/IGPP-78/17, NSF/RA-780510) Avail NTIS HC A07/MF A01 CSCL 081

A geophysical survey conducted in the region of the Salton Sea geothermal fields is discussed. Telluric sounding was utilized to determine the subsurface resistivity structure in order to indicate resistivity to a great depth. A wide span of frequencies were used in order to determine the electrical properties with depth. The correlation of high rock temperature and low resistivity is discussed and the Jacobian of the transformation matrix is calculated. Mappings of the resistivity of the area are presented.

A W H

**N79-33554#** Office of Technology Assessment Washington, D C

**MANAGEMENT OF FUEL AND NONFUEL MINERALS IN FEDERAL LAND: CURRENT STATUS AND ISSUES**

Apr 1979 444 p

(PB-295788/4, OTA-M-88) Avail NTIS HC A19/MF A01 CSCL 05A

The land management and disposal laws, policies, and practices that affect mineral exploration, development, and production on Federal onshore lands are analyzed. The discovery and production of minerals, including onsite processing and removal of the minerals from the mine site, and the effects on air, land, and water are discussed. The establishment of a mineral land management system that will identify and develop mineral resources in an environmentally safe manner is proposed.

A W H

**N79-33557** Clark Univ., Worcester Mass

**SHELTER DESIGN AND ENERGY USAGE. A METHODOLOGY FOR EVALUATING THE IMPACTS OF RESIDENTIAL SPACE CONDITIONING TECHNOLOGIES ON THE CONSUMER, THE ELECTRIC UTILITY, AND SOCIETY** Ph D Thesis

Robert M Wirtshafer 1979 242 p

Avail Univ Microfilms Order No 7923167

A 'total systems' methodology was developed to examine technologies for residential space conditioning including active and passive solar energy building design, and energy conservation. Assessment of each technology include measurement of cost effectiveness for the homeowner, impact on electric utility loads and finances, and societal benefits. Trade-offs between technologies and preferred public policy options were identified for the case study of Colorado Springs, Colorado.

Dissert Abstr

**N79-33558** Carnegie-Mellon Univ., Pittsburgh, Pa

**STUDIES OF AlGaAs-GaAs SOLAR CELLS** Ph D Thesis

Anel Flat 1979 157 p

Avail Univ Microfilms Order No 7919142

The operation of AlGaAs-GaAs solar cells are described. The interpretation of minority carrier diffusion length measurements by electron beam induced measurements and the development of contact grid patterns in concentration applications are discussed. Liquid phase epitaxy processing and diffusion studies of Zn in GaAs are considered.

Dissert Abstr

**N79-33560\*#** General Electric Co., Schenectady, N Y

**CONCEPTUAL DESIGN OF THERMAL ENERGY STORAGE SYSTEMS FOR NEAR TERM ELECTRIC UTILITY APPLICATIONS** Final Report

E W Hall, W Hausz, R Anand, N LaMarche, J Oplinger, and M Katzer Jul 1979 359 p refs Sponsored by NASA Prepared for DOE

(Contracts DEN3-12 EC-77-A-31-1034-2 EPRI Proj RP1082-1)

(NASA-CR-159577 GE79ET0101, DOE/NASA/0012-79/2) Avail NTIS HC A16/MF A01 CSCL 10B

Potential concepts for near term electric utility applications were identified. The most promising ones for conceptual design were evaluated for their economic feasibility and cost benefits. The screening process resulted in selecting two coal-fired and two nuclear plants for detailed conceptual design. The coal plants utilized peaking turbines and the nuclear plants varied the feedwater extraction to change power output. It was shown that the performance and costs of even the best of these systems could not compete in near term utility applications with cycling coal plants and typical gas turbines available for peaking power. Lower electricity costs, greater flexibility of operation, and other benefits can be provided by cycling coal plants for greater than 1500 hours of peaking or by gas turbines for less than 1500 hours if oil is available and its cost does not increase significantly.

R E S

**N79-33561\*#** Wyle Labs., Inc., Huntsville Ala

**INDOOR TEST FOR THERMAL PERFORMANCE OF THE SUNMASTER EVACUATED TUBE (LIQUID) SOLAR COLLECTOR**

Sep 1979 40 p Prepared for DOE  
(Contract NAS8-32036)  
(NASA-CR-161306, WYLE-TR-531-30R) Avail NTIS  
HC A03/MF A01 CSCL 10A

The test procedures used to obtain the thermal performance data for a solar collector under simulated conditions are presented. Tests included a stagnation test, a time constant test, a thermal efficiency test, an incident angle modifier test, and a hot fill test. All tests were performed at ambient conditions and the transient effect and the incident angle effect on the collector were determined. The solar collector is a water working fluid type. A W H

**N79-33564\*** Spire Corp., Bedford, Mass  
**INTEGRAL GLASS ENCAPSULATION FOR SOLAR ARRAYS**  
**Quarterly Progress Report**

Jun 1979 18 p Sponsored by NASA and DOE Prepared for JPL  
(Contract JPL-954521)  
(NASA-CR-162361, DOE/JPL-954521-79/2, QPR-10) Avail  
NTIS HC A02/MF A01 CSCL 10A

Progress in the development of permanent, integral glass encapsulation of terrestrial solar photovoltaic arrays by electrostatic bonding is reported. Two basic types of electrostatically bonded modules were demonstrated and their reliability proven in accelerated environmental testing. Economic analyses indicate that electrostatic bonding can be a cost effective, practical, and automatable process for large-scale production of arrays with lifetimes of more than 20 years. J M S

**N79-33566\*** ARCO Solar, Inc., Chatsworth, Calif  
**VACUUM DIE CASTING OF SILICON SHEET FOR PHOTO-VOLTAIC APPLICATIONS** Quarterly Report, 16 Mar. - 30 Jun. 1979

30 Jun 1979 31 p Sponsored by NASA and DOE Prepared for JPL  
(Contract JPL-955325)  
(NASA-CR-162360, DOE/JPL-955325-79/1, QR-1) Avail  
NTIS HC A03/MF A01 CSCL 10A

The development of a vacuum die-casting process for producing silicon sheet suitable for photovoltaic cells with a terrestrial efficiency greater than 12 percent and having the potential to be scaled for large quantity production is considered. The initial approach includes (1) obtaining mechanical design parameters by using boron nitride, which has been shown to non-wetting to silicon, (2) optimizing silicon nitride material composition and coatings by sessile drop experiments, (3) testing effectiveness of fluoride salt interfacial media with a graphite mold, and (4) testing the effect of surface finish using both boron nitride and graphite. When the material and mechanical boundary conditions are established, a finalized version of the prototype assembly will be constructed and the casting variables determined. A R H

**N79-33567\*** Siltec Corp., Menlo Park, Calif  
**LSA LARGE AREA SILICON SHEET TASK ENHANCED I D SLICING TECHNOLOGY FOR SILICON INGOTS** Quarterly Report, Feb. - Mar 1979

Dorothea Walters Apr 1979 22 p refs Sponsored by NASA and DOE Prepared for JPL  
(Contract JPL-955282)  
(NASA-CR-162359, DOE/JPL-955282-79/1, QR-1) Avail  
NTIS HC A02/MF A01 CSCL 10A

Development of inside diameter slicing technology to significantly increase the number of useable slices per inch of crystal over industry practice is discussed. The required reduction of both blade and slice thickness is to be accomplished by a combination of three key elements of slicing technology: (1) ingot rotation with minimum exposed blade area, (2) dynamic cutting edge control, and (3) the use of prefabricated insert blades. Design modifications on a slicing saw with microprocessor controls and hardware fabrication to complete this conversion were initiated. Several runs were conducted on the engineering saw incorporating the method of ingot rotation. Ingots with diameters up to six inches were sliced successfully on a production saw. K L

**N79-33568\*** Wyle Labs., Inc., Huntsville, Ala Solar Energy Systems Div

**INDOOR TEST FOR THERMAL PERFORMANCE OF THE GE TC-100 LIQUID SOLAR COLLECTOR EIGHT- AND TEN-TUBE CONFIGURATION**

Sep 1979 47 p Prepared for DOE  
(Contract NAS8-32036)  
(NASA-CR-161305, WYLE-TR-531-36R) Avail NTIS  
HC A03/MF A01 CSCL 10A

The thermal performance of a liquid solar collector was tested in eight- and ten-tube configurations under simulated conditions. A time constant test and an incident angle modifier test were also conducted to determine the transient and incident angle effects on the collector. Performance loss with accessory covers is demonstrated. The gross collector area is about 17.4 ft sq without manifold and 19.1 ft sq with manifold. The collector weight is approximately 60 pounds empty and 75 pounds with manifold. K L

**N79-33570\*** Owens-Illinois, Inc., Toledo, Ohio  
**OWENS-ILLINOIS SUBSYSTEM DESIGN PACKAGE FOR THE SEC-601 AIR-COOLED SOLAR COLLECTOR**

Feb 1979 19 p Prepared for DOE  
(Contract NAS8-32259)  
(NASA-CR-161094) Avail NTIS HC A02/MF A01 CSCL 10A

The subsystem design of the SEC-601 solar collector was evaluated. The collector is of modular design and is approximately 12 feet three inches wide and eight feet seven inches tall. It contains 72 collector tube elements and weighs approximately 300 pounds. Included in this report are the subsystem performance specifications and the assembly and installation drawings of the solar collectors and manifold. R E S

**N79-33571\*** National Aeronautics and Space Administration  
Langley Research Center, Hampton Va  
**NASA TECH HOUSE: AN EARLY EVALUATION**

1977 23 p refs  
(NASA-TM-80751) Avail NTIS HC A02/MF A01 CSCL 10A

An architect-engineering firm, as well as university participants, performed system studies, evaluated construction methods, performed cost effectiveness studies, and prepared construction drawings which incorporated the selected technology features into a final design. A Technology Utilization House (Tech House) based on this design was constructed at the NASA Langley Research Center in Hampton, Virginia. The Tech House is instrumented so that the performance of the design features and energy systems can be evaluated during a planned family live-in period. As such, the house is both a demonstration unit and a research laboratory. The Tech House is to demonstrate the kind of single-family residence that will probably be available within the next five years. G Y

**N79-33572\*** National Aeronautics and Space Administration  
Lewis Research Center, Cleveland, Ohio  
**ANNEALING OF RADIATION DAMAGE IN 01- AND 2-OHM-CENTIMETER SILICON SOLAR CELLS**

Irving Weinberg and Clifford K Swartz Oct 1979 13 p refs  
(NASA-TP-1559 E-9997) Avail NTIS HC A02/MF A01 CSCL 10A

Isochronal and isothermal annealing studies were conducted on 01 and 2 ohm centimeter n(+)/p silicon cells after irradiation by 1 MeV electrons at fluences of 10 to the 14th power, 5 times 10 to the 14th power, and 10 to the 15th power per square centimeter. For the 01 ohm centimeter cells, reverse annealing was not observed in the isochronal data. However, reverse annealing was observed between approximately 200 and 325 C in the isochronal data of the 2 ohm centimeter cells. Isothermal annealing of 01 ohm centimeter cells at 500 C restored pre-irradiation maximum power  $P_{sub max}$  within 20 minutes at fluence = 10 to the 14th power in 180 minutes at fluence = 5 times 10 to the 14th power and to 92 percent of pre-irradiation  $P_{sub max}$  in 180 minutes for fluence = 10 to the 15th power. Annealing at 450 C was found inadequate to

restore 0.1 ohm centimeter cell performance within reasonable times for all fluence levels. By comparison, at 450 C, the P sub max of 2 ohm centimeter cells was restored within 45 minutes, for the two highest fluence levels, while for the lowest fluence, restoration was completed within 15 minutes. Spectral response data indicate that, for both resistivities, degradation occurs predominantly in the cells p-type base region. Author

**N79-33573\*#** Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div  
**PHASE 1 OF THE FIRST SOLAR SMALL POWER SYSTEM EXPERIMENT (EXPERIMENTAL SYSTEM NO. 1). VOLUME 1: TECHNICAL STUDIES FOR SOLAR POINT-FOCUSING, DISTRIBUTED COLLECTOR SYSTEM, WITH ENERGY CONVERSION AT THE COLLECTOR, CATEGORY C Final Report**

T B Clark, ed 5 May 1979 294 p Prepared for JPL 3 Vol  
(Contract NAS7-100, JPL-955115)  
(NASA-CR-162369, U-6529-Vol-1) Avail NTIS  
HC A13/MF A01 CSCL 10A

The technical and economic feasibility of a solar electric power plant for a small community is evaluated and specific system designs for development and demonstration are selected. All systems investigated are defined as point focusing, distributed receiver concepts, with energy conversion at the collector. The preferred system is comprised of multiple parabolic dish concentrators employing Stirling cycle engines for power conversion. The engine, AC generator, cavity receiver, and integral sodium pool boiler/heat transport system are combined in a single package and mounted at the focus of each concentrator. The output of each concentrator is collected by a conventional electrical distribution system which permits grid-connected or stand-alone operation, depending on the storage system selected. K L

**N79-33574\*#** Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div  
**PHASE 1 OF THE FIRST SOLAR SMALL POWER SYSTEM EXPERIMENT (EXPERIMENTAL SYSTEM NO. 1). VOLUME 2: APPENDIX A - D Final Report**

T B Clark, ed 5 May 1979 279 p Prepared for JPL 3 Vol  
(Contract NAS7-100, JPL-955115)  
(NASA-CR-162370, U-6529-Vol-2) Avail NTIS  
HC A13/MF A01 CSCL 10A

Recommended conceptual designs for the baseline solar concentrator and electrical subsystems are defined, and trade offs that were evaluated to arrive at the baseline systems are presented. In addition, the developmental history of the Stirling engine is reviewed, the U4 configuration is described, and a Stirling engine heat pipe system is evaluated for solar application where sodium vapor is used as the heat source. An organic Rankine cycle engine is also evaluated for solar small power system application. K L

**N79-33575\*#** Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div  
**PHASE 1 OF THE FIRST SOLAR SMALL POWER SYSTEM EXPERIMENT (EXPERIMENTAL SYSTEM NO. 1). VOLUME 3: APPENDIX E - N Final Report**

T B Clark, ed 5 May 1979 187 p Prepared for JPL 3 Vol  
(Contract NAS7-100, JPL-955115)  
(NASA-CR-162371, U-6529-Vol-3) Avail NTIS  
HC A09/MF A01 CSCL 10A

The design of a solar electric power plant for a small community is reported. Topics covered include (1) control configurations and interface requirements for the baseline power system, (2) annual small power system output, (3) energy requirements for operation of the collectors and control building, (4) life cycle costs and reliability predictions, (5) thermal conductivities and costs of receiver insulation materials, (6) transient thermal modelling for the baseline receiver/thermal transport system under normal and inclement operating conditions, (7) high temperature use of sodium, (8) shading in a field of parabolic collectors, and (9) buffer storage materials. K L

**N79-33576\*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

**PHASE 1 OF THE FIRST SMALL POWER SYSTEM EXPERIMENT (ENGINEERING EXPERIMENT NO. 1). VOLUME 1. EXECUTIVE SUMMARY Final Report**

R J Holl May 1979 69 p Prepared for JPL 5 Vol  
(Contract NAS7-100, JPL-955117)  
(NASA-CR-162372, MDC-G7833-Vol-1) Avail NTIS  
HC A04/MF A01 CSCL 10A

The development of a modular solar thermal power system for application in the 1 to 10 MWe range is presented. The system is used in remote utility applications, small communities, rural areas, and for industrial uses. Investigations are performed on the energy storage requirements and type of energy storage, concentrator design and field optimization, energy transport, and power conversion subsystems. The system utilizes a Rankine cycle, an axial flow steam turbine for power conversion, and heat transfer sodium for collector fluid. A W H

**N79-33577\*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

**PHASE 1 OF THE FIRST SMALL POWER SYSTEM EXPERIMENT (ENGINEERING EXPERIMENT NO. 1). VOLUME 2. SYSTEM CONCEPT SELECTION Final Report**

R J Holl May 1979 312 p Prepared for JPL 5 Vol  
(Contract NAS7-100, JPL-955117)  
(NASA-CR-162373, MDC-G7833-Vol-2) Avail NTIS  
HC A14/MF A01 CSCL 10A

The development of a modular solar thermal power system for application in the 1 to 10 MWe range is presented. The system is used in remote utility applications, small communities, rural areas, and for industrial uses. Systems design and systems optimization studies are conducted which consider plant size, annual capacity factors, and startup time as variables. Investigations are performed on the energy storage requirements and type of energy storage, concentrator design and field optimization, energy transport, and power conversion subsystems. The system utilizes a Rankine cycle, an axial flow steam turbine for power conversion, and heat transfer sodium for collector fluid. A W H

**N79-33578\*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

**PHASE 1 OF THE FIRST SMALL POWER SYSTEM EXPERIMENT (ENGINEERING EXPERIMENT NO. 1). VOLUME 3: EXPERIMENTAL SYSTEM DESCRIPTIONS Final Report**

R J Holl May 1979 361 p Prepared for JPL 5 Vol  
(Contract NAS7-100, JPL-955117)  
(NASA-CR-162374, MDC-G7833-Vol-3) Avail NTIS  
HC A16/MF A01 CSCL 10A

The design and development of a modular solar thermal power system for application in the 1 to 10 MWe range is described. The system consists of five subsystems: the collector, power conversion, energy transport, energy storage, and the plant control subsystem. The collector subsystem consists of concentrator, receiver, and tower assemblies. The energy transport subsystem uses a mixture of salts with a low melting temperature to transport thermal energy. A steam generator drives a steam Rankine cycle turbine which drives an electrical generator to produce electricity. Thermal and stress analysis tests are performed on each subsystem in order to determine the operational reliability, the minimum risk of failure, and the maintenance and repair characteristics. A W H

**N79-33579\*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

**PHASE 1 OF THE FIRST SMALL POWER SYSTEM EXPERIMENT (ENGINEERING EXPERIMENT NO. 1). VOLUME 4: COMMERCIAL SYSTEM DEFINITION Final Report**

R J Holl May 1979 113 p Prepared for JPL 5 Vol  
(Contract NAS7-100, JPL-955117)  
(NASA-CR-162375, MDC-G7833-Vol-4) Avail NTIS  
HC A06/MF A01 CSCL 10A

The development and design of a modular solar thermal power system for application in the 1 to 10 MWe range is described. The system is used in remote utility applications, small communities, rural areas, and for industrial uses. The operational reliability, the minimum risk of failure, and the maintenance and

repair characteristics are determined and the commercial system design is defined A W H

**N79-33580\*** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif

**PHASE 1 OF THE FIRST SMALL POWER SYSTEM EXPERIMENT (ENGINEERING EXPERIMENT NO 1) VOLUME 5 SUPPORTING ANALYSES AND TRADE STUDIES Final Report**

R J Holl May 1979 210 p refs Prepared for JPL 5 Vol (Contracts NAS7-100 JPL-955117)  
(NASA-CR-162376 MDC-G7833-Vol-5) Avail NTIS  
HC A10/MF A01 CSCL 10A

The development and design of a modular solar thermal power system for application in the 1 to 10 MWe range is described. The system is used in remote utility applications, small communities, rural areas, and for industrial uses. Thermal and stress analyses are performed on the collector subsystem, energy storage subsystem, energy transport subsystem, the power conversion subsystem, and the plant control subsystem A W H

**N79-33581\*** United Technologies Corp South Windsor, Conn Power Systems Div

**ADVANCED TECHNOLOGY LIGHT WEIGHT FUEL CELL PROGRAM Final Report, 9 May 1977 - 16 Jun 1978**

R E Martin 16 Jun 1978 73 p refs  
(Contracts NAS3-20621 NAS3-20604)  
(NASA-CR-159653, FCR-1017) Avail NTIS  
HC A04/MF A01 CSCL 10A

A high performance hydrogen-oxygen alkaline fuel cell was investigated. Cell performance goals include 0.9 volts at a current density of 1000 amperes per sq ft for 3000 hours at a cell temperature up to 300 F and reactant pressure up to 250 psia. Subscale research cells were tested in the evaluation of five anode and five cathode catalyst configurations. Fuel cell matrices were fabricated from NASA supplied polybenzimidazole (PBI) powder. A cell edge frame and PBI matrix samples were corrosion tested in 42 wt% KOH at 250 F (121 C). A total of 13 828 hours of research cell testing at 250 F was completed. In addition 494 hours of testing at temperatures up to 300 F and reactant pressures up to 250 psia with 27 hours of operation at or above 0.9 V/c at 1000 ASF was completed. A supported platinum-on-carbon catalyst configuration demonstrated stable operation at high temperature. A new cell edge frame structure showed low weight loss during corrosion testing, an indication of the material stability and long life potential J M S

**N79-33582\*** Energy Research Corp Danbury, Conn  
**IMPROVEMENT OF PHOSPHORIC ACID FUEL CELL STACKS Interim Technical Report, Aug 1977 - Nov 1978**  
S G Abens, F J Ascenzo, B S Baker, G Garretson, and M Lambrecht May 1979 71 p refs  
(Contract DAAK70-77-C-0174)  
(AD-A070881) Avail NTIS HC A04/MF A01 CSCL 10/3

Phosphoric acid fuel cell components and stack assembly methods were evaluated. Electrodes with Pt loading between 0.3 and 0.9 g/sq ft were employed. Matrix materials were phenolic (Kynol) fibers and SiC Graphite bipolar plates with 33% phenolic resin binder were used. Stacks were tested on hydrogen and simulated reformed methanol for up to 6 800 hours. An 80-cell (2.1 kW) stack was built and delivered to MERAD-COM GRA

**N79-33583\*** Johns-Manville Sales Corp., Denver, Colo Research and Development Center  
**PERFORMANCE EVALUATION OF SOLAR FILMS AND SCREENS Final Report, 6 Jun - Sep 1978**  
Ronald R Bishop Apr 1979 75 p refs  
(Contract DAAK70-78-D-0002)  
(AD-A070636, USAFESA-TSD-2060) Avail NTIS  
HC A04/MF A01 CSCL 13/1

The use of solar films and screens to reduce energy usage is surveyed by means of Market and Literature Surveys that provide basic information on the availability, manufacture, function, cost, and solar optical properties of solar films and screens. A simplified method of determining potential energy savings is given in a step by step format that includes consideration of solar

heat gain, heat loss, and daylighting aspects of the application of solar films and screens. This simplified hand calculation procedure should provide an interim means of providing the energy saving information required by the Energy Conservation Investment Program. More sophisticated methods of calculation are under development by the Lawrence Berkeley Laboratory. At this time, it appears that for most regions of the country, flexible window shading that can be adjusted during the day or from season to season offer the most potential to saving energy GRA

**N79-33584\*** DCS Corp., Arlington, Va  
**STATUS OF THERMAL IMAGING TECHNOLOGY AS APPLIED TO CONSERVATION**

D L Shumaker, F J Snow, R C Barthle, T L Culp, and J T Wood Dec 1978 115 p  
(Contract EM-78-C-01-4228)  
(HCP/M4228-01) Avail NTIS HC A06/MF A01

The application of both imaging and non-imaging infrared equipment in the performance of thermal surveys is discussed and a concise up-to-date status of the commercial availability and performance of infrared surveys for the detection of heat loss/heat gain in buildings is provided DOE

**N79-33586\*** TRW Energy Systems, Redondo Beach, Calif  
**ANALYSIS OF BATTERY STORAGE FOR COMMERCIAL BUILDINGS, PHASE 1 Final Report**  
Sep 1978 107 p refs  
(Contract EC-77-C-02-4556)  
(COO-4556-2) Avail NTIS HC A06/MF A01

The application of battery storage to load leveling by the utility user represents a new concept in energy management. The possibility of combining an energy management computer/control system with a lead acid/power processor system was studied, and the feasibility of demonstrating power management at a government facility was explored. Candidate sites in the Washington D C metropolitan area were evaluated by analyzing demand curves for electricity. One site, the Department of the Treasury's Bureau of Printing and Engraving, is recommended as the best of the sites evaluated. Preliminary specifications are supplied. Facility modification and system layout are presented, giving alternate placements for the batteries. Floor loading and system safety are two critical design parameters DOE

**N79-33587\*** Mineral Economics Consultants, Inc., Swarthmore Pa  
**ENERGY REQUIREMENTS OF THE US PULP AND PAPER INDUSTRY**  
C M Cosman Jan 1979 119 p refs  
(Contract W-31-109-eng-38)  
(ANL/EES/TM-42) Avail NTIS HC A06/MF A01

The energy requirements of the U S pulp and paper industry were studied in an attempt to establish order of magnitude data. In view of the great divergency of products, processes, plant designs that reflect on specific energy consumption rates, it was not possible to provide much detail. The study is restricted to pointing out how public policy can help to channel the industry's efforts into less energy-intensive practices. Although recommendations are given, no specific process modifications were advised RES

**N79-33588\*** Department of Energy Denver, Colo  
**REGIONAL PROFILE, ENERGY-IMPACTED COMMUNITIES REGIONAL 8**  
Mar 1979 434 p  
(DOE/TIC-10001) Avail NTIS HC A19/MF A01

Data on population, administration, finance, housing, health, and safety, human services, education, and water and sewage for 325 energy-impacted communities are presented. A review of current and potential energy developments in the region shows over 900 energy resource impacts listed for the 325 impacted communities. Coal development represents over one third of the developments listed. Energy conversion initiatives represent another high incidence of energy resource impact, with uranium development following closely. These projections indicate continued development of regional energy resources to serve

national energy requirements The 325 impacted communities as reported Colorado (46) Montana (73), North Dakota (62), South Dakota (21), Utah (80) and Wyoming (43) illustrates that no area of the region will escape the impacts of energy development  
DOE

**N79-33589#** Argonne National Lab III Energy and Environmental Systems Div

**TRANSPORTATION ENERGY CONSERVATION (TEC) ENVIRONMENTAL DEVELOPMENT PLAN**

M J Bernard, III 1978 22 p Presented at DOE/TEC Div Highway Vehicle Systems Contractors' Coordinating Meeting, Troy, Mich 9-12 May 1978

(Contract W-31-109-eng-38)

(ANL/EES/CP-11 Conf-7805102-1) Avail NTIS HC A02/MF A01

The goal of the National Environmental Policy Act of 1969 is shown The act requires the preparation of Environmental Impact Statements (EIS) for major Federal actions significantly affecting the quality of the human environment The process, as implemented by DOE to produce an EIS for a technology program or demonstration is expected to have in chronological order, (1) an environmental development plan with annual updates (2) an environmental assessment (EA), a negative determination (ND) or a draft environmental impact statement (DEIS) and (3) a final environmental impact statement (EIS) The EA details the expected environmental impacts thus allowing the decision between preparing ND or a DEIS Public reviews of the DEIS are held for revisions before the EIS becomes finalized DOE

**N79-33591#** Little (Arthur D), Inc., Cambridge, Mass  
**IMPACT OF NATIONAL ENERGY AND ENVIRONMENTAL POLICIES ON INDUSTRY LOCATION DYNAMICS A METHODOLOGICAL REVIEW**

Feb 1979 222 p refs

(Contract EJ-78-C-01-2833)

(DOE/TIC-10129) Avail NTIS HC A10/MF A01

The findings are presented of a study performed to assess the pertinent theoretical and empirical literature on industry location dynamics, with emphasis on energy-intensive industries in order to help guide DOE's subsequent research activities in analyzing the impact of national energy and environmental policies on industrial location and regional growth patterns The nine chapters are entitled Summary, Identification of Energy-Intensive Industries for Analytical Emphasis, National Energy Policies and Their Implications for the Dynamics of Industrial Location Environmental Regulations and Their Implications for the Dynamics of Industrial Location for Energy-Intensive Industries, Industrial Location Theory, An Overview Empirical Analyses of Industrial Location Partial Equilibrium Location, Empirical Analyses of the Dynamics of Industrial Location General Equilibrium Approaches, Demonstration 1 A Partial Equilibrium Approach to an Analysis of the Impact of Energy Policies on the Dynamics of Industrial Location and Demonstration 2 Experimental Illustrative Application of the Partial Equilibrium Approach DOE

**N79-33592#** Swedish Council for Building Research Stockholm  
**STORAGE OF HEAT A SURVEY OF EFFORTS AND POSSIBILITIES**

Gunnar Wettermark, Bo Carlsson, and Hans Stymne 1979 162 p refs

(PB-295936/9 ISBN-91-540-2955-4) Avail NTIS HC A08/MF A01 CSCL 13B

Various methods are described for storing heat Topic areas discussed include the following the role of heat storage in different energy systems, heat storage with passive and active solar heat systems sensible heat latent heat - phase change thermochemical reactions the American program for storage of heat  
GRA

**N79-33593#** New Mexico Energy Inst Las Cruces  
**DEVELOPMENT OF RETROFIT ENERGY CONSERVATION AND SOLAR HEATING SYSTEMS, PHASE 1 Final Report**  
W Reed Edgel Sep 1978 138 p refs Sponsored in part by New Mexico Energy and Minerals Dept  
(PB-295847/8, NMEI-20) Avail NTIS HC A07/MF A01 CSCL 13A

The type and frequency of use of various construction systems and HVAC systems in existing buildings in New Mexico was examined Several of the most frequently occurring combinations of buildings and HVAC systems were selected and the materials components and subsystems which could be used in retrofit energy conservation and solar heating applications were identified When existing thermal envelope assessment and retrofit solar heating system design were complete performance and cost comparisons with the unimproved buildings were made to determine cost effectiveness and energy savings  
GRA

**N79-33594#** National Technical Information Service Springfield, Va

**FUEL CELLS, VOLUME 3 CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - Jun 1979**

Diane M Cavagnaro Jul 1979 244 p Supersedes NTIS/PS-78/0633, NTIS/PS-77/0544, NTIS/PS-76/0507, NTIS/PS-75/479, and COM-74-11533

(NTIS/PS-79/0717/3, NTIS/PS-78/0633, NTIS/PS-77/0544, NTIS/PS-76/0507, NTIS/PS-75/479 COM-74-11533) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Fuel cell applications, components, fabrication, design catalysts, and chemistry are covered The bibliography includes different types of fuel cells, such as hydrogen oxygen cells, hydrocarbon air cells, and biochemical cells This updated bibliography contains 235 abstracts 97 of which are new entries to the previous edition  
GRA

**N79-33595#** National Technical Information Service Springfield, Va

**HYDROCARBON FUEL CELLS CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Report, 1967 - Apr. 1979**

Diane M Cavagnaro Jul 1979 135 p Supersedes NTIS/PS-78/0651

(NTIS/PS-79/0718/1 NTIS/PS-78/0651) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

This bibliography cites worldwide research on hydrocarbon fuel cells The citations cover applications design, performance, fabrication, catalysts and electrochemistry This updated bibliography contains 128 abstracts 3 of which are new entries to the previous edition  
GRA

**N79-33596#** National Bureau of Standards, Washington, D C Building Thermal and Service Systems Div

**TESTING OF PEBBLE-BED AND PHASE-CHANGE THERMAL ENERGY STORAGE DEVICES ACCORDING TO ASHRAE STANDARD 94-77 Final Report**

Dennis E Jones and James E Hill May 1979 45 p refs Sponsored in part by DOE

(PB-295898/1 NBSIR-79-1737) Avail NTIS HC A03/MF A01 CSCL 10C

The American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) recently adopted ASHRAE Standard 94-77 Methods of Testing Thermal Storage Devices Based on Thermal Performance Experiments were completed at the National Bureau of Standards in which a 7 cu m (250 cu ft) pebble-bed and a similarly-sized 164 MJ (250,000 Btu) phase-change unit using sodium sulfate decahydrate both using air as the transfer fluid, were tested in accordance with this Standard A description of the test procedure, test apparatus and detailed test results is given Some problems were encountered in using the Standard for these kinds of thermal energy storage devices, and modifications to the Standard are recommended based on these experiments  
GRA

**N79-33597#** National Bureau of Standards, Washington D C Electron Devices Div

**STANDARDS FOR PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS Final Report, Feb - Sep 1978**

Harry A Schaft May 1979 19 p refs Prepared for Solar Energy Research Institute

(Contract EG-77-C-01-4042)  
(PB-296274/4, NBSIR-79-1743) Avail NTIS HC A02/MF A01 CSCL 10B



The results are presented of a search for existing domestic standards and related documents for possible application in the development of a standards base for photovoltaic energy conversion systems. The search resulted in locating about 150 test methods, recommended practices, standards, solar-thermal performance criteria, and other standards-related documents. They are listed by topic areas in the appendix. The listing was prepared to assist those involved in developing performance criteria for photovoltaic systems and in identifying methods of test system performance against these criteria. It is clear from the results of the search that few standards are directly applicable to terrestrial solar photovoltaic systems and that much standard development is required to support the commercialization of such systems.

GRA

**N79-33598#** United Nations Industrial Development Organization, Vienna (Austria)

**TECHNOLOGY FOR SOLAR ENERGY UTILIZATION**

Hans Kleinrath, U G Bhide, and Jean Paul Durand 1978 160 p Sponsored in part by Agency for International Development

(PB-296572/1) Avail NTIS HC A08/MF A01 CSCL 10A

Work being done in various countries and institutions dealing with (1) the conversion of solar energy into mechanical or electrical energy, (2) the design of solar collectors, (3) the utilization of solar energy in heating, cooling, distillation, drying and cooking, and (4) the transfer of technology is presented.

GRA

**N79-33599#** State Univ of New York at Albany Atmospheric Sciences Research Center

**NEW YORK STATE SOLAR ENERGY ATLAS**

Jul 1978 182 p Sponsored by NY State Energy R and D Authority

(PB-295453/5, NYSEDA-78/5) Avail NTIS HC A09/MF A01 CSCL 10A

Total horizontal solar radiation measurements through 1978 for New York State are presented in hourly, daily, and monthly formats. Tables, maps, and charts describing this total irradiation at 15 New York State locations compose the bulk of the atlas. An explanatory text serves as a guide to the material, and a section of climatological tables for temperature, heating and cooling degree days, and cloud cover is included. For many solar energy applications, solar irradiation is better represented in terms of its direct and diffuse components. The results of five months of direct and diffuse solar irradiation measurements at three New York State sites is presented.

GRA

**N79-33600#** New Mexico Energy Inst, Las Cruces  
**DIELECTRIC DEVELOPMENT FOR GaAs SOLAR CELLS**  
**Technical Completion Report**

W W Granneman (N Mex Univ, Albuquerque) and Chien-Sheng Su (N Mex Univ, Albuquerque) Jan 1979 27 p Sponsored in part by New Mexico Energy and Minerals Dept  
(PB-295837/9, NMEI-21) Avail NTIS HC A03/MF A01 CSCL 10B

Gallium phosphate passivation on gallium arsenide was studied for use in gallium arsenide solar cells. The gallium phosphate has good antireflective characteristics when applied to gallium arsenide. Metal-gallium phosphate-gallium arsenide capacitors were constructed so that capacitance versus voltage measurement could be made. Interface state densities were determined from the c-v curve. The fast interface state densities were excellent and the corresponding surface recombination velocities should be low. Using this passivation layer should yield a major improvement in gallium arsenide solar cell efficiency.

GRA

**N79-33601#** International Science and Technology Inst, Inc., Washington, D C

**DEVELOPING SMALL HYDROELECTRIC DAM POTENTIAL**

Mary Lyon-Allen Apr 1979 19 p Sponsored by Community Services Admin

(PB-296238/9, CSA/LN-2391, CSA/Pam-6143-12) Avail NTIS HC A02/MF A01 CSCL 10B

This is a report to inform local governments, legislators, Community Action Agencies, Community Development Corpora-

tions, and other community organizations of the importance of hydropower as a method to alleviate the impact of high energy prices on low-income persons. The potential of small hydro development is discussed as well as suggestions for communities to begin the process of feasibility assessment.

GRA

**N79-33602#** Applied Physics Lab, Johns Hopkins Univ, Laurel, Md

**ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Jan. - Mar 1979**

Apr 1979 29 p ref Sponsored in part by DOE

(PB-296217/3, APL/JHU-EQR-79-1) Avail NTIS HC A03/MF A01 CSCL 10A

The report is divided into three sections. The first, Geothermal Energy Development Planning, contains reports on the progress of those geothermal related tasks where effort was concentrated during the quarter. The tasks include an ongoing Atlantic Coastal Plain Geothermal Energy Market Survey, the Delmarva Geothermal Development Prospectus, Evaluation of Federal Strategies for Hydrothermal Developments, and comments on limited tasks performed in support of the major tasks. The second section, Operational Research, Hydroelectric Power Development, includes reports on a method for quantifying institutional constraints and on institutional and regulatory restraints in New Jersey. The third section, Energy Conversion and Storage Techniques, contains a report on flywheel development.

GRA

**N79-33603#** Community Services Administration, Washington, D C

**SOLAR ENERGY POLICY**

Jan 1979 57 p refs

(PB-296193/6, CSA/NF-03, CSA/Pam-6143-10) Avail NTIS HC A04/MF A01 CSCL 13A

The energy-related problems of the poor and near-poor are described. Including their lack of funds with which to pay sharply increasing utility bills, the decline in health and deterioration in living conditions when increasing numbers of families have to choose between food and energy, and in the cases of the elderly and the handicapped, a challenge to survival which they face. The Community Service Administration's energy-related policy goals are detailed.

GRA

**N79-33605#** National Technical Information Service, Springfield, Va

**ENERGY SUPPLY AND DEMAND MODELING A BIBLIOGRAPHY WITH ABSTRACTS Report, 1964 - May 1979**

Audrey S Hundemann Jul 1979 151 p Supersedes NTIS/PS-78/0599

(NTIS/PS-78/0685, NTIS/PS-78/0599) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

The use of energy models to estimate the supply and demand of electricity, oil, natural gas, coal, and petroleum products on national, regional, and state levels is discussed. The models cover residential, commercial, and industrial supply and demand, the impact of economic conditions on demand, energy use alternatives, and optimal allocation of regionally produced energy resources. Abstracts pertaining to design and development of energy models are included.

GRA

**N79-33607#** Educational Facilities Labs, Inc., New York  
**A REPORT ON THE DEVELOPMENT OF A MODEL ENERGY MANAGEMENT PROGRAM FOR NEW YORK STATE SCHOOLS, PHASE 2**

Jul 1978 144 p

(PB-295452/7, NYSEDA-78/7) Avail NTIS HC A07/MF A01 CSCL 13A

Topic areas covered include implementation of energy management programs, goals and elements of the plan, administrative organization, suggested activities and organizational strategies, incentive considerations, program cost estimates.

GRA

**N79-33608#** National Technical Information Service, Springfield, Va

**STATE-OF-THE-ART REVIEWS AND BIBLIOGRAPHIES ON ENERGY A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1984 - May 1979**

Audrey S Hundeman Jul 1979 316 p Supersedes NTIS/PS-78/0586 and NTIS/PS-77/0520  
(NTIS/PS-79/0639/9, NTIS/PS-78/0586 NTIS/PS-77/0520)  
Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

Citations to bibliographies state-of-the-art reviews, and literature surveys on various aspects of fossil fuels wind, solar energy hydrogen, geothermal energy nuclear energy and batteries are presented A few citations pertain to electric power (This updated bibliography contains 310 abstracts, 96 of which are new entries to the previous edition) GRA

**N79-33609 California Univ, Los Angeles ENVIRONMENTAL, SOCIOECONOMIC, AND CONSUMER PROTECTION ASPECTS OF SELECTED DECENTRALIZED SOLAR ENERGY APPLICATIONS Ph.D. Thesis**

Steven Robert Sim 1979 202 p  
Avail Univ Microfilms Order No 7921455

The solar market was studied to determine if a meaningful amount of consumer problems with solar power had arisen Extensive literature searches, widespread public comment and reaction field visits to operating solar units, and a national workshop were utilized The conclusions reached indicated that at least 20 percent of solar consumers experienced significant problems especially in installation of the units Potential for future electricity generation through the conversion of solar energy was determined The environmental and socioeconomic aspects of decentralized photovoltaic wind, and solar thermal technologies were discussed The conclusions indicated that environmental impacts of such technologies are relatively minor and those which existed are of the nature of public health considerations

Dissert Abstr

**N79-33611\*# National Aeronautics and Space Administration Langley Research Center Hampton, Va**

**MEASUREMENT TECHNIQUES FOR TRACE METALS IN COAL-PLANT EFFLUENTS A BRIEF REVIEW**

Jag J Singh Washington Oct 1979 34 p refs  
(NASA-RP-1047 L-13164) Avail NTIS HC A03/MF A01 CSCL 13B

The strong features and limitations of techniques for determining trace elements in aerosols emitted from coal plants are discussed Techniques reviewed include atomic absorption spectroscopy charged particle scattering and activation, instrumental neutron activation analysis gas/liquid chromatography, gas chromatographic/mass spectrometric methods, X-ray fluorescence, and charged-particle-induced X-ray emission The latter two methods are emphasized They provide simultaneous, sensitive multielement analyses and lend themselves readily to depth profiling It is recommended that whenever feasible, two or more complementary techniques should be used for analyzing environmental samples K L

**N79-33614# California Univ, Berkeley Lawrence Berkeley Lab**

**AQUATIC MICROCOSMS FOR ASSESSMENT OF EFFLUENT EFFECTS Final Report**

John Harte, D Levy, E Lapan A Jassby, M Dudzik and J Rees Nov 1978 98 p refs  
(Contract W-7405-eng-48 EPRI Proj 939-1)  
(EPRI-EA-936) Avail NTIS HC A05/MF A01

Laboratory freshwater lake microcosms were studied with respect to their usefulness in providing a tool for environmental impact assessment Three four month studies were carried out, each with a different pollutant expected to be found in significant concentration in the aqueous effluent from coal gasification operations These studies have led to (1) identification of those biological and chemical parameters most useful for evaluating the responses of microcosms to chemical pollutants, (2) characterization of the difficulties in obtaining replicate microcosms that approximately simulate natural systems, (3) a test of the usefulness of microcosms in evaluating hypothetical stability indicators (4) evaluation of the relative usefulness of the bloom and the quiescent stages of microcosm development for impact assessment studies and (5) a specific research plan

for determining optimum procedures for microcosm design initiation, and operation DOE

**N79-33639# SRI International Corp Menlo Park Calif MODELING OF STATIONARY AIR POLLUTION SOURCES IN THE CENTRAL AND WESTERN KERN COUNTY OIL FIELDS TASK REPORT VOLUME 1 TEXT**

Patricia B Simmon F L Ludwig and Kenneth C Nitz Jan 1979 117 p refs

(Contract EPA-68-01-4137)

(PB-294812/3 SRI-5258-7-Vol-1) Avail NTIS HC A06/MF A01 CSCL 13B

Air quality was assessed in two locations of Kern County the oil fields in the central portion of the county near Bakersfield and the oil fields well to the west of Bakersfield lying on a roughly NW to SE line about 40 miles in length, between the towns of McKittrick and Maricopa Data describing the meteorological conditions the measured SO<sub>2</sub> levels, and inventories of both generator and nongenerator sources were collected and reduced A limited verification of data detailing generator source characteristics, particularly location was performed GRA

**N79-33648# National Oceanic and Atmospheric Administration, Boulder Colo Environmental Research Labs**

**PROCEEDINGS OF A WORKSHOP ON SCIENTIFIC PROBLEMS RELATING TO OCEAN POLLUTION**

Edward D Golberg ed (Scripps Inst of Oceanog, La Jolla Calif) Mar 1979 229 p refs Conf held at Estes Park Colo 10-14 Jul 1978

(PB-297467/3 NOAA-79061309) Avail NTIS HC A11/MF A01 CSCL 13B

Ocean pollution research, development and monitoring needs are discussed Specific topics covered include synthetic organic compounds chlorination products dredging and disposal of its large volume waste, artificial radionuclides, microorganisms, trace metals biostimulants fossil fuel compounds and biological effects GRA

**N79-33654# KVB Inc Minneapolis Minn FIELD TESTS OF INDUSTRIAL STOKER COAL FIRED BOILERS FOR EMISSION CONTROL AND EFFICIENCY IMPROVEMENT. SITE B Final Report Dec 1977 - Mar 1978**

J E Gabrielson, P L Langsjoen, and T C Kosvic Apr 1979 113 p

(Contract EF-77-C-01-2609)

(PB-295535/9) Avail NTIS HC A06/MF A01 CSCL 13B

The results of field measurements made on a 200,000 lb/hr spreader stoker boiler were given The effect of various parameters on boiler emissions and efficiency was studied Parameters studied included overfire air, flyash reinjection, excess air, boiler load, and fuel properties Measurements included gaseous emissions, particulate emissions, particle size distribution of the flyash, and combustible content of the ash Gaseous emissions measured were O<sub>2</sub>, CO<sub>2</sub>, CO NO SO<sub>2</sub>, and SO<sub>3</sub> in the flue gas Sample locations included the boiler outlet, multiclone outlet, and electrostatic precipitator outlet In addition to test results and observations the facility tested coals fired test equipment, and procedures are presented GRA

**N79-33664 Colorado School of Mines, Golden MODAL ANALYSIS OF SEISMIC GUIDED WAVES IN COAL SEAMS Ph.D. Thesis**

Steven Douglas Peterson 1978 127 p

Avail Univ Microfilms Order No 7918309

The propagation and dispersion of seismic waves within coal are analyzed to determine the properties of coal and the character of its seams using a modal wave theory Dissert Abstr

**N79-33699# Oak Ridge Associated Universities Tenn Inst for Energy Analysis**

**UNCERTAINTIES ASSOCIATED WITH GLOBAL EFFECTS OF ATMOSPHERIC CARBON DIOXIDE**

R M Rotty Mar 1979 29 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA-79-6(0)) Avail NTIS HC A03/MF A01

Although the evidence is quite clear that the increase in atmospheric CO<sub>2</sub> is at least to a large degree a result of fossil fuel burning and it is equally clear that this increase will result in some change in the global climate there are quantitative uncertainties that require additional understanding before full assessments can be made. There are also quantitative uncertainties regarding the natural carbon cycle, the behavior of the various reservoirs when perturbed by man, the terrestrial biosphere, and the rate at which the oceans can assimilate and store carbon. There are uncertainties in regard to the climate change that can result from increased atmospheric CO<sub>2</sub>. Progress in modeling the atmosphere must continue to narrow these uncertainties before the impacts of climate change on man can be adequately determined. The future demands for fossil fuels are uncertain. The growth of the developing world will be closely linked to fossil energy for the next five to eight decades. Only the observed increase in the atmospheric concentration and the present (and recent past) rate of production of CO<sub>2</sub> from fossil fuels provide data without uncertainties. DOE

**N79-33881\*#** Boeing Computer Services Inc. Seattle, Wash. Energy Technology Applications Div  
**AN EXPANDED SYSTEM SIMULATION MODEL FOR SOLAR ENERGY STORAGE (TECHNICAL REPORT), VOLUME 1 Final Report**

A W Warren Aug 1979 107 p refs 2 Vol

(Contracts DEN3-42 EX-76-A-31-1026)

(NASA-CR-159601 DOE/NASA/0042-79/1-Vol-1,

BCS-40159-1) Avail NTIS HC A06/MF A01 CSCL 09B

The simulation model for wind energy storage (SIMWEST) program now includes wind and/or photovoltaic systems utilizing any combination of five types of storage (pumped hydro battery thermal flywheel and pneumatic) and is available for the UNIVAC 1100 series and the CDC 6000 series computers. The level of detail is consistent with a role of evaluating the economic feasibility as well as the general performance of wind and/or photovoltaic energy systems. The software package consists of two basic programs and a library of system environmental and load components. The first program is a precompiler which generates computer models (in FORTRAN) of complex wind and/or photovoltaic source/storage/application systems from user specifications using the respective library components. The second program provides the techno-economic system analysis with the respective I/O the integration of system dynamics, and the iteration for conveyance of variables. A R H

**N79-33882\*#** Boeing Computer Services, Inc., Seattle Wash. Energy Technology Applications Div  
**AN EXPANDED SYSTEM SIMULATION MODEL FOR SOLAR ENERGY STORAGE (UNIVAC OPERATION MANUAL REVISIONS), VOLUME 2 Final Report**

A W Warren Aug 1979 198 p refs 2 Vol

(Contracts DEN3-42 EX-76-A-31-1026)

(NASA-CR-159602, DOE/NASA/0042-79/2-Vol-2

BCS-40180-2-Rev) Avail NTIS HC A09/MF A01 CSCL 09B

Additions or revisions of components of the SIMWEST program are provided for insertion into the manual used with the UNIVAC 1100 series computer. A R H

**N79-33883\*#** Boeing Computer Services Inc. Seattle, Wash. Energy Technology Applications Div  
**SIMWEST A SIMULATION MODEL FOR WIND AND PHOTOVOLTAIC ENERGY STORAGE SYSTEMS (CDC USER'S MANUAL), VOLUME 1 Final Report**

A W Warren and A W Esinger Aug 1979 486 p refs 2 Vol

(Contracts DEN3-42, EX-76-A-31-1026)

(NASA-CR-159607 DOE/NASA/0042-79/3-Vol-1,

BCS-40262-1) Avail NTIS HC A21/MF A01 CSCL 09B

Procedures are given for using the SIMWEST program on CDC 6000 series computers. This expanded software package

includes wind and/or photovoltaic systems utilizing any combination of five types of storage (pumped hydro battery, thermal, flywheel, and pneumatic). A R H

**N79-33884\*#** Boeing Computer Services Inc., Seattle, Wash. Energy Technology Applications Div  
**SIMWEST A SIMULATION MODEL FOR WIND AND PHOTOVOLTAIC ENERGY STORAGE SYSTEMS (CDC PROGRAM DESCRIPTIONS), VOLUME 2 Final Report**

A W Warren, R W Edsinger and J D Burroughs Aug 1979

247 p 2 Vol

(Contracts DEN3-42 EX-76-A-31-1026)

(NASA-CR-159608, DOE/NASA/0042-79/4-Vol-2,

BCS-40262-2) Avail NTIS HC A11/MF A01 CSCL 09B

The computer programs for the CDC version of SIMWEST (1979 revision) are described. Macro flow charts and source code listings for each major program entity are presented. A R H

**N79-34006#** General Accounting Office Washington, D C Div of Energy and Minerals  
**FEDERAL FACILITIES FOR STORING SPENT NUCLEAR FUEL, ARE THEY NEEDED**

27 Jun 1979 42 p

(PB-297071/3 EMD-79-82) Avail NTIS HC A03/MF A01 CSCL 18G

The question of whether commercial spent fuel is processed and how and where spent fuel is permanently stored is considered. G R A

**N79-34044#** Los Alamos Scientific Lab., N Mex  
**MHD DECELERATION OF FUSION REACTION PRODUCTS**

S Chow and I O Bohachevsky Apr 1979 20 p refs

(Contract W-7405-eng-36)

(LA-7778-MS) Avail NTIS HC A02/MF A01

The feasibility of magnetohydrodynamic (MHD) deceleration of fuel pellet debris ions exiting from an inertial confinement fusion (ICF) reactor cavity was investigated using one-dimensional flow equations. For engineering reasons, induction-type devices are emphasized. Their performance characteristics are similar to those of electrode-type decelerators. Results presented indicate that MHD decelerators can be designed within conventional magnet technology to not only decelerate the high-energy fusion pellet debris ions, but also to produce some net electric power in the process. DOE

**N79-34074\*#** ESC Energy Corp. Daly City, Calif  
**DISTRIBUTION AUTOMATION AND CONTROL SUPPORT; ANALYSIS AND INTERPRETATION OF DAC WORKING GROUP RESULTS FOR USE IN PROJECT PLANNING**

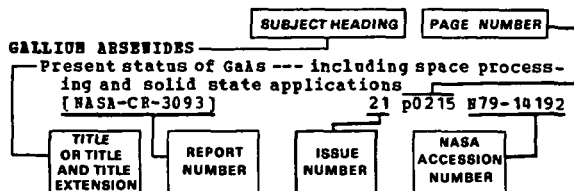
Peter Klock and Dave Evans Apr 1979 16 p

(Contract JPL-955231)

(NASA-CR-162331) Avail NTIS HC A02/MF A01 CSCL 10B

The Executive Summary and Proceedings of the Working Group Meeting was analyzed to identify specific projects appropriate for Distribution Automation and Control DAC RD&D. Specific projects that should be undertaken in the DAC RD&D program were recommended. The projects are presented under broad categories of work selected based on ESC's interpretation of the results of the Working Group Meeting. Some of the projects are noted as utility industry projects. The ESC recommendations regarding program management are presented. Utility versus Government management responsibilities are noted. M M M

## Typical Subject Index Listing



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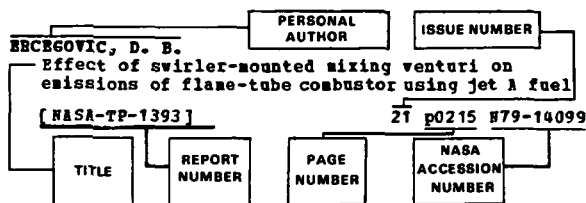


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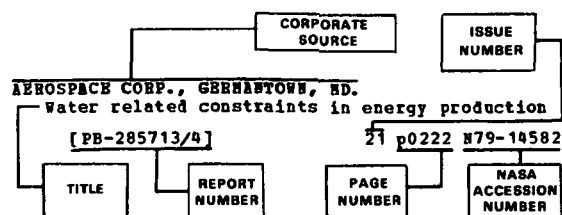
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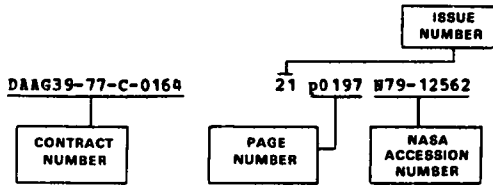
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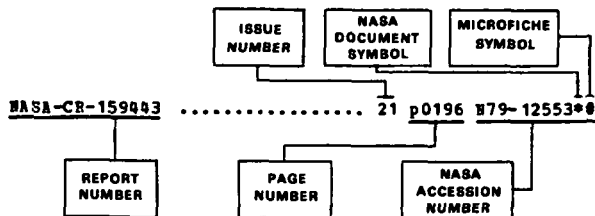
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US-PATENT-CLASS-15-230.16	21	p0172	N79-10422*	US-PATENT-CLASS-428-133	21	p0172	N79-10422*
US-PATENT-CLASS-15-230.17	21	p0172	N79-10422*	US-PATENT-CLASS-429-13	21	p0172	N79-10513*
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US-PATENT-CLASS-29-572	23	p0579	N79-26475*				
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US-PATENT-CLASS-29-578	23	p0579	N79-26475*	US-PATENT-3,262,694	22	p0353	N79-19447*
US-PATENT-CLASS-29-580	23	p0579	N79-26475*	US-PATENT-4,098,142	21	p0172	N79-10422*
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US-PATENT-CLASS-33-281	24	p0730	N79-29037*	US-PATENT-4,104,084	21	p0182	N79-11467*
US-PATENT-CLASS-44-51	21	p0179	N79-11152*	US-PATENT-4,104,134	21	p0182	N79-11469*
US-PATENT-CLASS-60-508	22	p0348	N79-18443*	US-PATENT-4,105,517	21	p0182	N79-11470*
US-PATENT-CLASS-60-572	22	p0348	N79-18443*	US-PATENT-4,121,995	21	p0179	N79-11152*
US-PATENT-CLASS-60-641	22	p0348	N79-18443*	US-PATENT-4,122,214	21	p0182	N79-11472*
US-PATENT-CLASS-73-12	23	p0569	N79-25443*	US-PATENT-4,122,833	21	p0182	N79-11471*
US-PATENT-CLASS-73-82	23	p0569	N79-25443*	US-PATENT-4,131,336	21	p0217	N79-14529*
US-PATENT-CLASS-74-572	21	p0172	N79-10422*	US-PATENT-4,131,486	21	p0217	N79-14528*
US-PATENT-CLASS-117-35	22	p0352	N79-19186*	US-PATENT-4,135,367	22	p0348	N79-18443*
US-PATENT-CLASS-126-270	21	p0182	N79-11471*	US-PATENT-4,143,314	22	p0357	N79-20179*
US-PATENT-CLASS-126-270	23	p0546	N79-23481*	US-PATENT-4,148,295	23	p0546	N79-23481*
US-PATENT-CLASS-126-270	23	p0557	N79-24432*	US-PATENT-4,149,521	23	p0557	N79-24433*
US-PATENT-CLASS-126-271	21	p0182	N79-11471*	US-PATENT-4,149,817	23	p0557	N79-24432*
US-PATENT-CLASS-126-271	21	p0217	N79-14529*	US-PATENT-4,153,134	23	p0551	N79-23555*
US-PATENT-CLASS-126-271	22	p0348	N79-18443*	US-PATENT-4,153,476	23	p0570	N79-25482*
US-PATENT-CLASS-126-271	23	p0546	N79-23481*	US-PATENT-4,154,084	23	p0569	N79-25443*
US-PATENT-CLASS-126-271	23	p0557	N79-24433*	US-PATENT-4,156,309	23	p0579	N79-26475*
US-PATENT-CLASS-126-400	23	p0557	N79-24433*	US-PATENT-4,159,576	24	p0730	N79-29037*
US-PATENT-CLASS-136-89CA	23	p0570	N79-25482*	US-PATENT-4,165,460	24	p0768	N79-31706*
US-PATENT-CLASS-136-89CC	21	p0182	N79-11467*				
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US-PATENT-CLASS-136-89SJ	23	p0570	N79-25482*				
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